CHEMICAL
& METALLURGICAL
# ENGINEERING

NOVEMBER, 1942

Factories sprung from last year's cornfields have already changed many Midwestern horizons. War production has drawn heavily on the rich resources and inherent resourcefulness of that vast inland empire. Perhaps a third of the nation's chemical manpower is directly or indirectly involved. All chemical engineers are vitally concerned, first, with getting this job done and, then, with clearing the way for the problems of reconstruction. This issue of *Chem. & Met.* salutes "Midwestern Resources and Resourcefulness" as they will be dramatized in the Second National Chemical Exposition in Chicago, Nov. 24-9.

Chem & Met

NEXT MONTH

In the December issue, Chem. & Met. editors will report on new developments in equipment and materials of construction which were exhibited at Chicago's Chemical Exposition and at New York's Power Show. Coverage will stress new ideas in equipment maintenance, and particular emphasis will be given to the use of non-critical materials for equipment and building construction as well as for their necessary upkeep and repair.

Production of electrolytic caustic soda and chlorine will be described and illustrated in the December Pictured Flowsheet.

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CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

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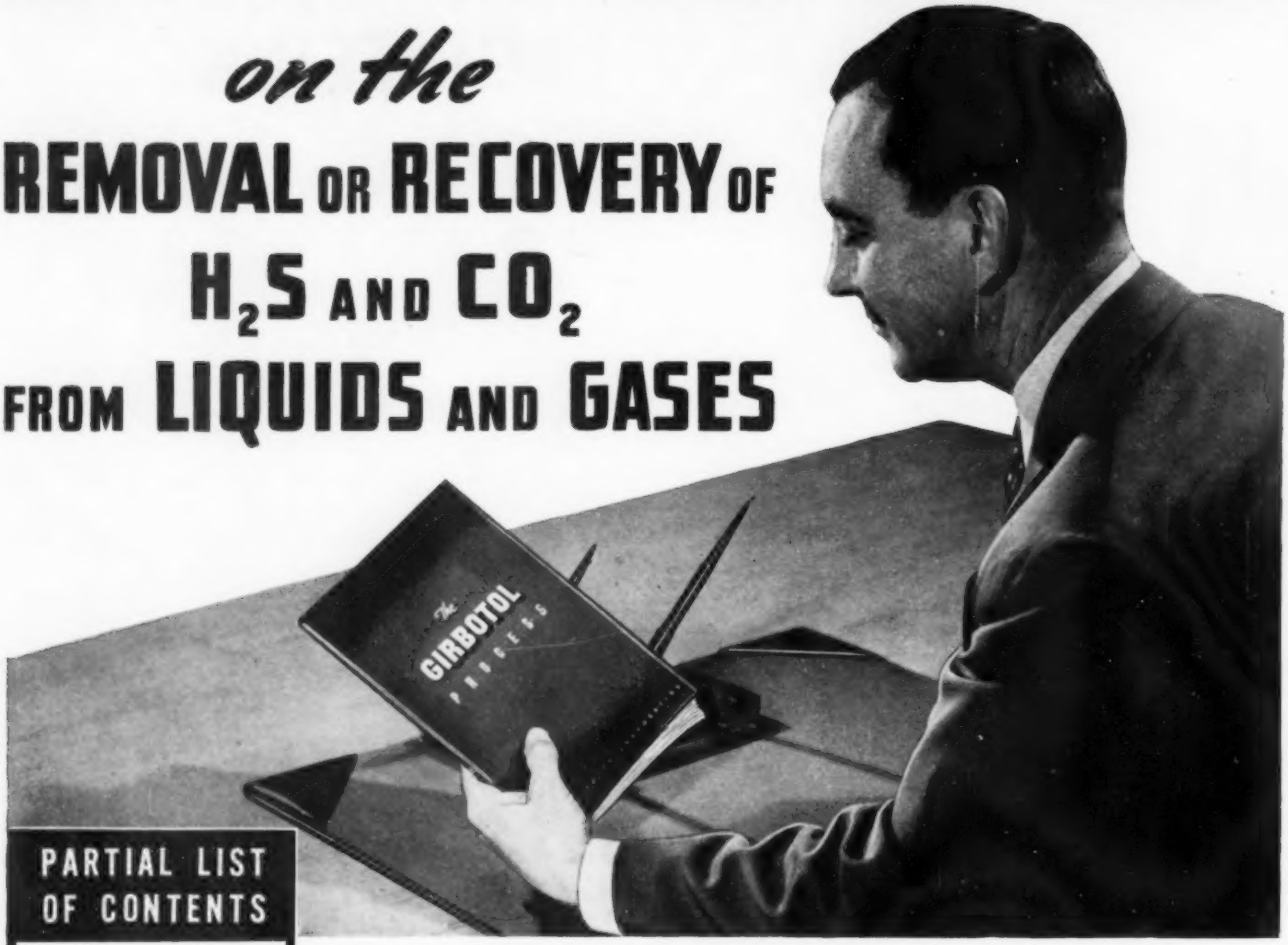

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ENGINEERING

ESTABLISHED 1902

S. D. KIRKPATRICK, *Editor*

NOVEMBER, 1942

RESOURCES AND RESOURCEFULNESS

Suppose we explore together a few channels of thought that are suggested by these two words: "Resources" and "Resourcefulness." Both are exceedingly important in these critical times. Yet we here in the United States have been inclined to think too much about the former and too little about the latter. We are just now beginning to realize that resources without resourcefulness may prove more of a liability than an asset.

Certainly what has happened so far in this great global war should cause us to ponder a little as we look over the balance sheet of world resources. The United Nations at the beginning of the war controlled three-quarters of the iron and steel capacity, two-thirds of the aluminum, 93 percent of the copper, 100 percent of the tin, petroleum and rubber. Today the Axis powers have wrested from us 57 percent of the world's pig iron capacity, half the steel, 58 percent of the aluminum, 65 percent of the tin and 89 percent of the rubber. A sixth of the world's copper and petroleum capacities are in enemy hands. Even the future of our food supply is threatened as Axis powers have multiplied six-fold their share of wheat and cattle and have tightened their hold on almost four-fifths of the world's potatoes.

We may well ask ourselves how our enemies, holding the short end of the lever, have made themselves so strong that they now control more of some vital materials than we do. Part of the answer, of course, is that they took unfair advantage of us; they violated their pledged word; they conspired and plotted our destruction while we were blindly pursuing our peaceful ways. Part of the answer, too, is that they worked harder and longer and did without luxuries; they chose the hard end of the dilemma in their choice of "Guns instead of Butter."

But the most significant thing that Germany did in her whole *ersatz* program was to replace her resources with researches. Lacking our great natural resources, she mobilized her technical resourcefulness and never before in the history of the world has so much been done with so little in the way of strategic raw materials. The result is as much a victory for her scientists and engineers as it is for her fighting forces.

John Collyer, able president of the Goodrich company, has recently likened the war work of our technologists to the tactical importance of the Commandos. In helping to dedicate Cornell's new Olin Hall of Chemical Engineering earlier last month, he said: "Neither millions of men nor billions of dollars can be thrown into the war effort effectively until these first Commando attacks of the scientists are successful. . . . Modern war on land and sea—and in the stratosphere and under the sea—is plotted in the laboratories. Here the commandos of science and engineering have been hard at work. Their initiative, skill and perseverance have made it possible for us to get over hurdles quickly. They have been confronted with many barriers that had to be cleared away before the full strength of our arms could be employed."

All this has a bearing on the big job that is ahead for all of us. We need to utilize to the full not only our resources but also our inherent resourcefulness. We need to apply more science and technical ingenuity to the whole war effort. We need mass production of new and more deadly implements of war. We need to work harder and longer—without waiting for Washington to waste

our time and energies wrangling over rules and regulations. We have what it takes to win but we won't unless we match our rich resources with greater resourcefulness.

WE SALUTE THE MIDDLE WEST

For her bountiful supplies of agricultural and mineral resources. Nowhere else in the world has Nature concentrated such wealth in a comparable area.

For the energy, enthusiasm and integrity of her people. Nothing can stand in their way once they set their will toward accomplishment.

For the strength and utility of her industries. They supply fundamenetal human needs of the nation for food, clothing, shelter, health and transportation.

For the part she is playing in the war effort. The Middle West is truly the arsenal as well as the granary and meat shop of democracy.

For the recent industrialization and diversification of her economy. Both agriculture and industry have gained strength and stability.

For the trend toward sounder integration of agriculture and industry. A better balance of farm and factory is in the making.

For the number and character of her schools and colleges. They hold a leading place among our institutions of higher learning.

For the recognition that is accorded research and development. Her laboratories have contributed more than their share of recent advances in science and technology.

For the close bond between academic and industrial research. Her universities have benefitted themselves and in turn benefitted industry by encouraging a two-way flow of ideas and inventions.

For the spirit of enterprise and independence of her chemists and chemical engineers. Their courage and perseverance has been put to test in planning and pushing forward with their program for a second National Chemical Exposition in Chicago, November 24-29.

For the able leadership that has been provided by the Exposition Committee of the Chicago Section of the American Chemical Society. Under the chairmanship of Victor Conquest of Armour & Co., it has met and overcome many discouraging obstacles.

For, in short, all of her rich resources and her remarkable human and industrial resourcefulness in their development and use.

WASHINGTON HIGHLIGHTS

SPONGE IRON has become a subject of controversy between WPB and the Bureau of Mines. Unfortunately, much of the difference is either personal controversy or a mere misuse of the technical words involved. Many people still think that the old-fashioned sponge-iron processes are both technically impractical and economically unsound, even for war time. This is probably true. The Bureau of Mines in its proposals regarding direct reduction of iron ore is not talking about those old procedures. The Bureau proposes radically modified new plans which apparently have considerable merit, at least under certain limited local conditions. It is unfortunate that these new developments are being criticized in some cases largely because they have been inaccurately named "sponge iron" or inadequately described.

SPEED in war time is essential. Excessive speed is, however, unfortunate. The old adage "Haste makes waste" must be carefully observed. We might safely paraphase it also as "Hurry makes worry." This is peculiarly true of the continuous process-industry operations which for sake of smoothness, overall effectiveness, and maximum production must not be unduly rushed. When the pressure comes from the executive office or from Washington for speeds beyond those that are wise, there should be great care taken to point out that overall production is greater when hourly rates are within reason.

SALARIES for chemical engineers must not exceed $25,000 per year after taxes are paid and authorized deductions have been settled. Most *Chem. & Met.* readers will not lose very much sleep worrying over this limitation. But we can well give some thought to the fact that this "reform" was effected by presidential rather than legislative prescription. Next time the "medicine" might not be so palatable!

WHISKEY DISTILLERIES now make only industrial alcohol as the result of a tremendous shift in their technology made to aid the war effort. One more change is going to be necessary. They will have to learn to use wheat instead of corn. Hence there will be no let-up in the technical problems for this division of the process industry. Hence also the need for maintaining technical skills despite the draft and increases in voluntary enlistment.

POWER SHORTAGES next year now threaten electrochemical industry. Cessation of new construction on hydroelectric plants and steam-electric plant extensions leaves a dangerously narrow margin for next year. Furthermore, this threat comes at a time when the army and navy requirements impose increasing demands for chlorine, ferro alloys and other products of electric furnaces and cells. All who can increase electrochemical and electrometallurgical production should do so. Those who can find ways to do without the products of this division of industry may have to do that also.

TARIFF on rubber at the end of the war will lead to a third world war—at least that is the dismal forecast of Vice President Wallace. It shows the extent to which American policies are going to be reviewed for the purpose of international trading in ideas as well as in goods. Fortunately, it is not at all necessary that there be official decisions on these matters at this time. And it is doubtful whether Mr. Wallace in his extreme view will be as influential as might now appear when the actual time of decision arrives. Certainly there is no gain for anyone in talking about post-war tariffs.

CHEM & MET REPORT ON

RESOURCES and RESOURCEFULNESS of the MIDDLE WEST

"Watch the Middle West!" That's the advice of a high governmental official who is in a peculiarly favorable position to foresee industrial trends. Already there is evidence that a revolutionary change is in process as the war program has brought a desirable industrialization and diversification to what has heretofore been a predominately agricultural economy. Huge governmental projects and greatly stimulated war industries have created a better balance between farm and factory. More people are working more productively than ever before in our history. If we can but carry some of that same activity and enterprise into our peace-time economy, an even greater future is assured for this vast Midwestern Empire. To reach that difficult objective will call for the fullest utilization of the rich resources and inherent resourcefulness of this region that already produces almost a third of the products of the chemical process industries. It is a clearcut challenge for chemical engineers of vision, energy and ability.

CHEMICAL & METALLURGICAL

ENGINEERING • NOVEMBER 1942

Rich Resources

PROVIDE LIMITLESS SOURCES OF RAW MATERIALS

Chem. & Met. INTERPRETATION

That vast inland empire west of the Alleghenies, east of the Rockies and north of Tennessee has long been this country's bread basket and butcher shop. It has filled the coal bins, provided the lumber, iron and steel, glass, lead and zinc for our shelters, the wool and leather for our clothing. Now, in the nation's time of need, its great arsenals, huge ammunition and explosives plants, its tank and automotive factories are turning out more munitions than any other section of the country. Among the factors that have made this possible are, first, and perhaps most important, the abundance of natural resources. Nowhere else in the world is there comparable concentration of agricultural, mineral and chemical resources. Nearly every raw material for industry is available, most of them in almost limitless supply. These are certain to become more important to chemical engineers now intent on turning out materials that will help the war effort, but on whom must eventually rest much of the responsibility for the future growth and development of the Middle responsibility for the future development of the Middle West.

FROM MINE, FARM AND FOREST

It was no accident that concentrated fully a third of the chemical process industries within the fourteen Middle Western states. Surprising thing is that there are not more such plants. Coal and salt, petroleum and natural gas, limestone and most of the other mineral raw materials of chemical industry are available in abundance. An outstanding exception is native sulphur, but pyrites and zinc blende are available and would be used in greater quantities for making sulphuric acid were it not for the low price at which Gulf-Coast brimstone can be brought up the Mississippi to most of the consuming industries.

Adequate, low-cost transportation had a lot to do with the development of Midwestern resources. Short hauls by rail, highway or waterway, bring raw materials to manufacturing plants that can distribute finished products more widely and more economically than is possible from most other parts of the country. Chicago, Detroit, Cleveland, Milwaukee and St. Louis have benefitted by their location on navigable waterways. The Great Lakes alone normally account for a quarter of the total of U. S. water-borne transportation. The Mississippi, Ohio and Missouri rivers carry an increasing share of the traffic. But, by and large, it is the efficient network of Midwestern railroads that has been responsible for the tremendous spread of industry in this region that has more miles of tracks than any other comparable section in the United States. Looking still further ahead to the greater use of air transportation in the future, practically every city of any size in this area has or is developing its own airport facilities.

From the mines, quarries and oil wells of the fourteen Middle Western states are produced about 30 percent of the total value of mineral products for the entire United States. West Virginia takes the leading place with coal, natural gas, and petroleum contributing most and in that order. Illinois takes second place, again with petroleum, coal, stone and cement as the ranking products. Next comes Kansas where zinc production falls into third place behind her oil and gas. Ohio is fourth among the mineral producers of the Middle West, but ranks ninth in the country as a whole. Ohio's clay products amount in value second only to coal. Kentucky follows although as a coal producer she has been exceeded only by West Virginia, Pennsylvania and Illinois. Michigan creeps in slightly ahead of Minnesota despite the fact that iron ore is the chief mineral in each state. The latter's premier position as an ore producer is more than offset by Michigan's output of petroleum, cement and copper.

There is an appreciable drop from Minnesota's 2.51 percent of the U. S. total to Indiana's 1.25 percent and Missouri's 1.08 percent. Coal makes the difference, and more than offsets Missouri's output of 37.2 percent of the nation's lead supply in 1939. None other of the fourteen states produces 1 percent of the country's mineral values—not even South Dakota which is No. 3 among the U. S. gold producers.

That the chemical process industries follow in somewhat the same pattern as the minerals is not surprising. Chemical utilization of coal, petroleum and natural gas would alone determine that. But, of course, there are other mineral raw materials that are less valuable in the aggregate but are of greater specific importance to chemical industry. For example the brines of Michigan and Southern Ohio, Missouri's barytes, fluorspar in Illinois and Kentucky, glass sand, gypsum, etc. The accompanying map and tabulation summarize the mineral and farm production of the 14 Middle Western States. On page 84 of this issue is a comparable map and supporting data for the distribution of the chemical process industries. Ohio, Illinois, Indiana, Michigan, Wisconsin, and

West Virginia are the ranking states. Note that in 1939 the area that produced 29.13 of mineral values had 31.21 percent of chemical values.

First among the products of the forest, as far as chemical engineers in the Middle West are concerned, is the pulp wood that supplies the important pulp and paper industries of Wisconsin, Michigan, Ohio, Minnesota and Illinois. Hardwood distillation is a ranking process industry only in Michigan. Tanning materials and extracts are of still less importance. But there is increasing production of plywood requiring synthetic resin and other chemical adhesives. Wood flour is used in a filler in plastics and there has lately been an increasing interest in lignin plastics and various pulp wood products.

But in the broad scheme of things in the Middle West, the products of mine and forest are much less important than those of the farm. The fertile soil and high productivity of the Corn Belt are legendary. Year after year these states lead the world in grain production per acre, per square mile and per state.

Not so well known as the grain crops is the rapid progress that has been made in growing soybeans for both feed and market. The heavy concentration of this industry in Illinois, Iowa, Indiana and Ohio, together with minor contributions from Michigan and Missouri, accounts for fully 90 percent of the nation's total. This has already led to an important processing industry with an increasing list of useful products other than staple oil and meal.

Flaxseed is another Middle Western monopoly with more than half of the U. S. total in Minnesota and with approximately 85 percent concentrated in Minnesota, North and South Dakota, Iowa and Kansas. Greater utilization of both the seed and fiber are proceeding apace as our imports have been cut by difficulties of ocean shipping.

The synthetic rubber industry's insistent demand for butadiene, together with the large quantities of ethyl alcohol required for smokeless powder and other munitions, has focused a great deal of attention on the utilization of corn and wheat as chemical raw material.

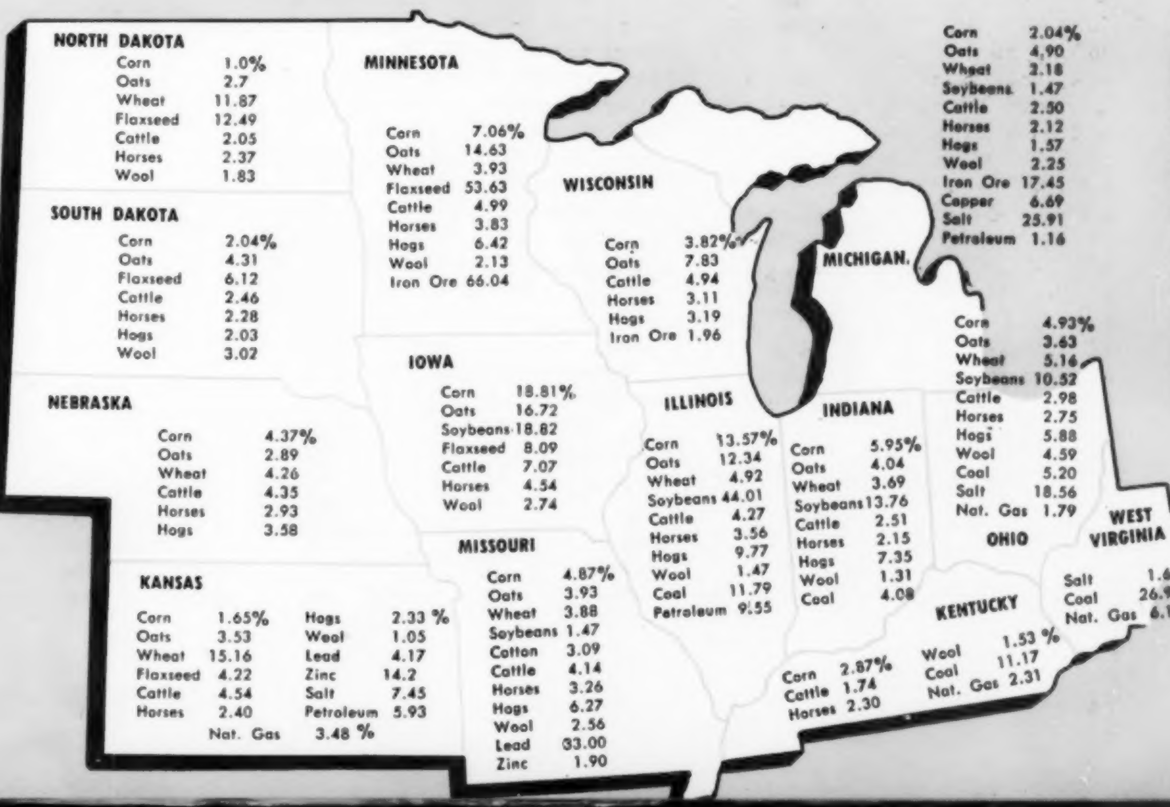
In the Northern Regional Research Laboratory of the U. S. Department of Agriculture, the so-called science or field of "chemurgy" is being put under the microscope and into pilot plant demonstrations to give a sounder basis on which to build industries that can utilize to the fullest extent the rich agricultural resources of the Middle West.

SELECTED FARM AND MINERAL PRODUCTS OF THE MIDDLE WEST

(Based on compilation of Mississippi Valley Assoc., May 1942)

(Showing percentage of total U. S. production except where it amounts to less than 1 percent).

STATES	Farm Products, 1940							Mineral Products, 1939								
	Corn	Oats	Wheat	Soybeans	Flaxseed	Percent Total U. S. Farm Income	Rank Among States in Farm Income	Coal	Salt	Petroleum	Natural Gas	Iron Ore	Lead	Limestone	Percent Total U. S. Value of Mineral Products	Rank Among States in Minerals
Illinois	13.57	12.34	4.92	44.01		6.26	4	11.79		9.55				7.98	4.97	6
Indiana	5.95	4.04	3.69	13.76		4.02	6	4.08						3.85	1.26	19
Iowa	18.81	3.93		18.82	8.09	7.98	1							6.38	.60	31
Kansas	1.65	3.53	15.16		4.22	3.21	10		7.45	5.93	3.38		4.10	3.08	2.91	8
Kentucky	2.87	3.				1.75	19	11.17			2.31			4.55	2.67	11
Michigan	2.04	4.90	2.18	1.47		2.70	14		25.91	1.16		17.45		10.88	2.74	10
Minnesota	7.06	14.63	3.93		53.63	4.69	5					66.04		1.26	2.51	12
Missouri	4.87	3.93	3.88	1.47		3.31	9						33.00	3.82	1.08	21
Nebraska	4.37	2.89	4.26			3.05	13							.42	.10	43
North Dakota	1.00	2.70	11.87		12.49	1.71	20								.06	46
Ohio	4.93	4.04	3.69	10.52		3.79	7	5.20	18.56		1.79			10.78	2.83	9
South Dakota	2.04	4.31	3.21		6.12	1.62	21								.59	32
West Virginia						.46	44	26.96	1.61		6.19	1.96		2.85	6.51	4
Wisconsin	3.82	7.83				3.45	8							2.68	.30	36
Total for Midwest	72.98	69.07	56.79	90.05	84.55	48.00		59.20	53.53	16.64	13.77	85.45	37.10	58.53	29.13	



RESOURCES

Remarkable Resourcefulness

PAVES THE WAY FOR INDUSTRIAL PROGRESS

Chem. & Met. INTERPRETATION

This war has proved that resources without resourcefulness are more of a liability than an asset. Fortunately, the Middle West has both. Her people are a match in ingenuity and productivity for the wealth of her resources and the fertility of her soil. Thus she has so highly developed her agriculture and industry that they are known and envied throughout the world. But, as this war has also proved, a better balance of farm and factory is greatly to be desired. There are still many challenging opportunities for new industries even though most of them will have to wait until the war is over. Those who are to meet this challenge and carry forward the Midwest's program of industrialization and diversification are the technically trained men and women in our schools and colleges, research and development laboratories and in engineering and administrative positions in industry. Their resourcefulness is treated in these pages.

FROM SCHOOL, LABORATORY AND PLANT

Technically-trained manpower is a good measure of a people's resourcefulness. The number of college graduates, particularly from scientific and professional courses, is an index of industrial progress. So too are the numbers of research laboratories and of their staffs of skilled investigators. And because so many of the new problems of industrial development are essentially chemical in character, it is always helpful to know the approximate number of chemists and chemical engineers available to do a given job.

By all these measures of resourcefulness the 14 Middle Western states shown in the accompanying map rank unusually high when compared with other sections of the United States. With 34 percent of the nation's population, they have 37 percent of the colleges and professional schools. Enrollment in these institutions of higher learning totals 522,990 men and women, which is 35 percent of the total for the entire United States. More than 800 of the country's 2,237 industrial research laboratories (as of 1938) are located in these states. Their total research personnel at that time exceeded 15,000 or 34.28 percent of the total for all such American laboratories.

Authentic figures for the number of chemists and chemical engineers in these states are lacking but in the accompanying tabulation we have estimated that there are approximately 20,000 people of such training in the Middle West. Not all are employed in the chemical process industries, of course, but it is interesting to observe that this area also accounts for 28.17 percent of the plants and 31.21 percent of the total value of products. (See map and table on page 84.)

When the National Roster of Scientific and Specialized Personnel was undertaken as an aid to the war effort, it was hoped that we might have from it, for the first time an adequate census of chemists and chemical engineers. If such totals have been compiled, they are apparently regarded as military secrets for they have not been made available to the general public. Perhaps after the war is over they will be published as historical data in the private papers of some of our governmental officials. Meanwhile the most recent and comprehensive data we have are the figures obtained last year in the questionnaire survey of the committee on the economic status of members of the American Chemical Society and published in *Chemical and Engineering News,* for Oct. 25, 1942.

This committee, under the chairmanship of Dr. Lawrence W. Bass, received replies to its questionnaire from 19,009 members, of whom 16,104 were identified as senior and 1,255 as junior male members. Female members and those for whom sex was not reported totalled 1,644. Of the male members 22.3 percent of the seniors and 29.2 percent of the juniors were chemical engineers while 71.8 percent and 64.9 percent, respectively, reported chemistry as their major field. Other fields, including those of science and engineering, accounted for 5.9 percent of the senior males and 5.7 percent of the junior males. From 1926 to 1941 the number of chemical engineers increased from 1,712 to 4,168 or to 243 percent. The number of chemists increased from 6,120 to 13,641 or to 223 percent. In both cases the largest growth occurred between 1934 and 1937.

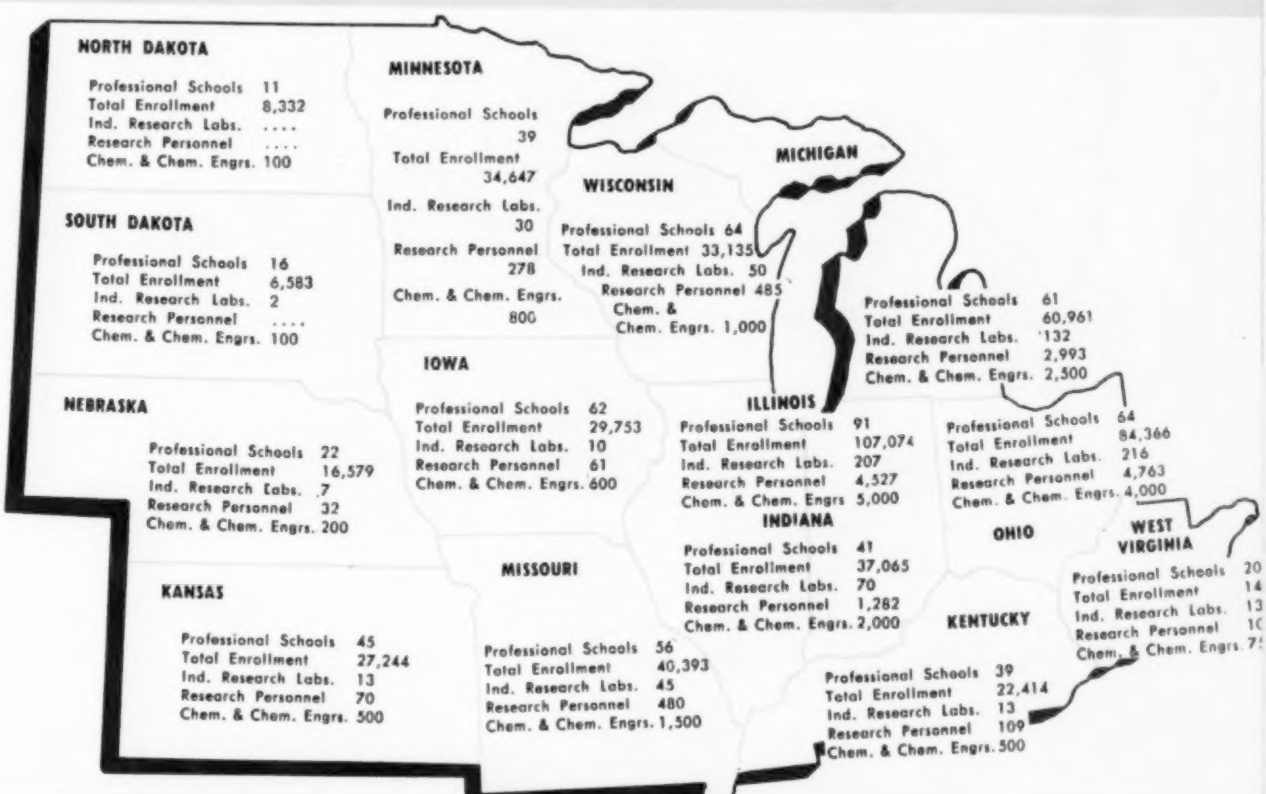
Distribution by geographic districts has not yet been published in sufficient detail to make possible direct comparisons with the estimates given here but in 1941 the East North Central and West North Central regions totalled 29.1 percent of the U.S. total. The proportions in East North Central—Illinois, Ohio, Indiana, Michigan and Wisconsin—increased from 22.7 percent in 1926 to 23.6 percent in 1941. In the latter year Illinois reported 8.4 percent against 6.7 percent for Ohio and

8.5 percent for the other three states combined.

In the East North Central region only about a third of the members are employed in communities of 100,000 or less population while in the West North Central the proportion was nearly half. This is largely explained by the fact that in Illinois 70.8 percent of those reported lived in cities of over 500,000, as compared with only 28.3 percent in Ohio and less in some of the states without such large cities.

years 1920 to 1938. A more detailed study of these data was made by George Perazich and Philip M. Field for the Works Projects Administration's National Research Project and published in January, 1940, as its Report No. M-4. (See also *Chem. & Met.* September, 1939, pp. 523-5.) From this source were taken the figures shown in the accompanying table and map. It will be noted therein that in 1938 Ohio led in the Middle West both in the total number of laboratories and in research personnel. Illinois is second, followed by Michigan, Indiana and Wisconsin. In the Chemical and Allied Industries, however, Michigan went into the lead over Ohio in 1938 with more than twice the research personnel of Illinois.

Inadequate as are these figures as true measures of inherent resourcefulness, they are nevertheless indicative of a great creative force that is actively at work in developing the agricultural, mineral and chemical resources of the Middle West.



Technical Manpower

AND RESOURCEFULNESS

Perhaps the best conclusion one can draw from these figures is that the number of chemists and chemical engineers has been growing steadily during the past 15 years and has more than kept pact with the advance of industry. The Middle West has maintained, and in fact has slightly increased, its proportion of the country's total chemical personnel.

Illuminating statistics are readily available on research laboratories and personnel, thanks to the systematic surveys conducted by the National Research Council during the

DISTRIBUTION OF TECHNICAL MANPOWER IN 14 MIDWESTERN STATES

STATE	*Research Personnel* — *Chemicals and allied industries*		*Research Personnel* — *Total for all industries*		*Total College Enrollment*	*Estimated number of Chem. & Chem. Engrs.*
	1927	1938	1927	1938	1939–40	1942
Illinois	151	462	1,810	4,527	107,074	5,000
Indiana	120	244	401	1,282	37,065	2,000
Iowa	.....	9	4	61	29,753	600
Kansas	.....	.....	38	70	27,244	500
Kentucky	.....	29	2	109	22,414	500
Michigan	194	923	954	2,993	60,961	2,500
Minnesota	9	61	53	278	34,647	800
Missouri	59	116	166	480	40,393	1,500
Nebraska	7	4	20	32	16,579	200
North Dakota	.....	.....	.....	.....	8,332	100
Ohio	223	778	2,100	4,763	84,366	4,000
South Dakota	.....	.....	.....	.....	6,583	100
West Virginia	40	84	109	104	14,444	750
Wisconsin	123	37	277	485	33,135	1,000
Total for 14 States	926	2,747	5,934	15,184	522,990	19,550
Total for United States	3,463	9,542	18,982	44,292	1,493,203	60,000
Percent in Midwest	26.73	28.78	31.26	34.28	35.02	32.58

Sources: Data on Schools and Enrollment from U. S. Office of Education. "Summary of Statistics of Higher Education," 1939–40.
Data on Research Personnel from "Industrial Research and Changing Technology," Nat. Res. Project, W. P. A., Jan. 1940.

Why Midwest Makes More Munitions

Chem. & Met. INTERPRETATION

Those who are most responsible for planning the national defense program back in 1940 began by setting up a "safety zone" that was bounded by an indefinite border roughly 200 miles inland from any sea coast. Wherever possible, new plant facilities for war production were located within this protected territory. Gradually, too, another principle was recognized and largely accepted. As first enunciated by Agricultural Commissioner Chester C. Davis of the old National Defense Advisory Board, it was that "no new defense industries should be located in areas where the heavy industries essential to the defense are already concentrated." This move was made to tap new reservoirs of unemployed labor as well as undeveloped resources and materials. The Middle West, in particular, benefitted by this program and up to the time we actually entered into the war, this area accounted for fully 60 percent of the total new industrial facilties. Since then there have been larger projects for shipbuilding and aircraft that have been located outside of this territory but it is significant that 45.72 percent of the new war-industry plants are to be found in the Middle Western states. Contracts for all war supplies are distributed more widely but these states account for 36.79 percent of the almost 80 billion dollars that had been contracted up to August 1, 1942.

GRADUALLY the rest of the United States is catching up with the Middle West in defense plant construction. When *Chem. & Met.* last reviewed the distribution of contracts for industrial facilities (see April, 1941, pp. 98-9), the 14 Middle Western states accounted for 49.8 percent of the U. S. total for plants of all types including shipbuilding and aircraft. For the more limited classification of "Arms, Ammunition and Explosives," in which chemical industry is most interested, the Midwest's proportion exceeded 65 percent. According to the most recent figures released by the Statistics Division of WPB, the proportion for total facilities had dropped to 35.63 percent and for industrial facilities to 45.72 percent. Detailed data are no longer publishable for chemical munitions as such.

That this is still a larger share of war production facilities than that of any other regional group of states is apparent from the tabulations shown below and from the map on the opposite page. The per capita value of all war contracts is $644.74 for the Middle Western states as compared with $597.81 for the U. S. average. With 34.10 percent of the population, the area has 36.79 percent of the dollar value of contracts awarded up to August 1, 1942. This totals almost thirty billions of dollars.

Michigan has lately moved into first place among the states, having received more than 10 percent of all war contracts awarded since June, 1940. This results, of course, from the progress being made in the conversion of the automobile industry and the heavy production of tanks, aircraft, engines and other automotive equipment. Ohio is next among

DISTRIBUTION OF MAJOR WAR FACILITIES PROJECTS IN THE MIDDLE WESTERN STATES

June 1940 through July 1942

States	*Industrial Facilities Projects (000 omitted)*	*Rank of States in U. S. A.*	*Total Facilities Projects (000 omitted)*	*Rank of States in U. S. A.*
Illinois	$1,024,026	4	$1,174,233	5
Indiana	893,230	5	1,049,682	8
Iowa	151,645	28	173,278	34
Kansas	240,923	19	346,369	19
Kentucky	171,554	26	307,822	25
Michigan	1,028,471	3	1,070,894	7
Minnesota	264,856	17	268,909	29
Missouri	498,828	9	634,327	10
Nebraska	154,316	27	242,838	31
North Dakota	....	48	....	48
Ohio	1,100,572	2	1,203,009	4
South Dakota	150	47	50,617	42
West Virginia	259,341	18	260,793	30
Wisconsin	388,908	11	440,724	15
Total of 14 Midwest States	6,176,820	..	7,223,495	..
Total for U. S. A.	13,509,765	..	20,271,907	..
Percent in Midwest States	45.72	..	35.63	..

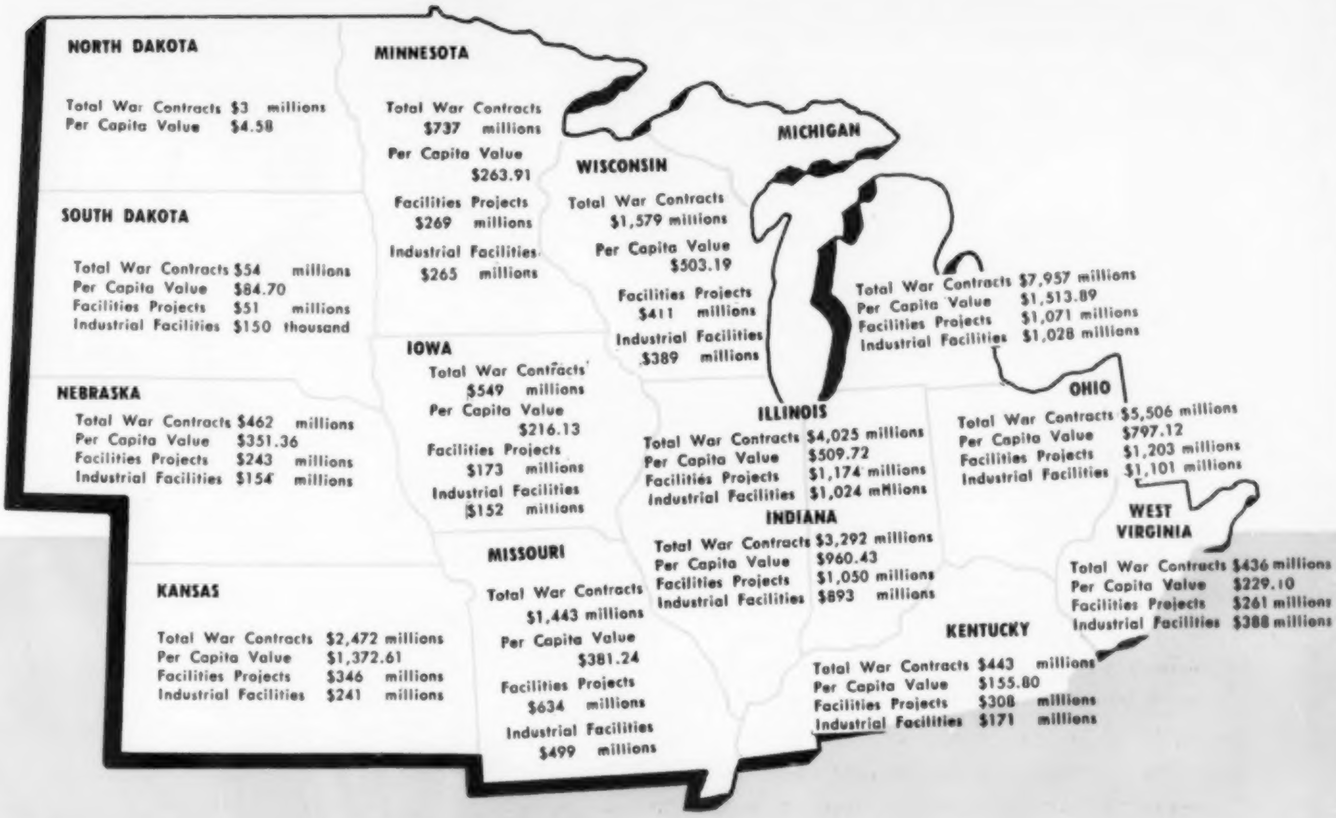
Compiled by George C. Smith, Department of Industrial Development, M-K-T RR, St. Louis, Mo., from official releases of Statistics Division, War Production Board.

DISTRIBUTION OF WAR SUPPLY AND FACILITY CONTRACTS IN MIDDLE WESTERN STATES

June 1940 through July 1942

States	*Population (1940)*	*Dollar Value of Contracts Awarded (000 omitted)*	*Rank of States in U. S. A.*	*Per Capita Value of Contracts*	*Rank of States in U. S. A.*
Illinois	7,897,241	$4,025,353	7	$509.72	20
Indiana	3,427,796	3,292,172	9	960.43	9
Iowa	2,538,268	548,598	27	216.13	35
Kansas	1,801,028	2,472,112	11	1,372.61	4
Kentucky	2,845,627	443,332	31	155.80	43
Michigan	5,256,106	7,957,188	1	1,513.89	2
Minnesota	2,792,300	736,921	21	263.91	30
Missouri	3,784,664	1,442,868	16	381.24	25
Nebraska	1,315,834	462,336	29	351.36	28
North Dakota	641,935	2,942	48	4.58	48
Ohio	6,907,612	5,506,186	4	797.12	11
South Dakota	642,961	54,461	45	84.70	46
West Virginia	1,901,975	435,742	33	229.10	34
Wisconsin	3,137,587	1,578,818	15	503.19	21
Total for 14 Midwest States	44,899,933	28,959,029	..	644.74	..
Total for U. S. A.	131,669.275	78,713,192	..	597.81	..
Percent in Midwest States	34.10	36.79	..	......	..

Compiled by George C. Smith, Department of Industrial Development, M-K-T RR, St. Louis, Mo., from official releases of Statistics Division, War Production Board.



War Supplies and Facilities

the Middle Western states but in the nation is exceeded by California and New York. New Jersey and Pennsylvania come in ahead of Illinois' share, which alone exceeds four billions of dollars. Indiana has a sizable total of three and a third billions and ranks ninth in the nation. Kansas is in eleventh place nationally but is second only to Michigan in per capita value of her war contracts.

From the accompanying table it will be seen that the Middle West can claim the states with both the largest and the smallest totals of war contracts. North Dakota is the forty-eighth ranking state with per capita contracts of only $4.58 as compared with $1,513.89 for Michigan, and $2,101.92 for Connecticut.

Turning now to plant awards, it is interesting to note that government contracts for facilities have more than trebled since the first of the year when they were valued at slightly less than $6 billion. Of the total for continental United States of $20.27 billions, about 65 percent were for industrial facilities. In this category it is of interest to note that Ohio was nosed out of first place in July by Pennsylvania but only by about $5 millions. In turn Michigan was in third place and Illinois in fourth place in the nation, yet contracts in all three states exceeded $1 billion each. They accounted for more than half of the total for industrial facilities for the 14 Middle Western states.

On the basis of total facilities, which includes cantonments, army and navy bases, etc., Texas takes first rank among all the states and both California and Pennsylvania exceed Ohio. Illinois goes ahead of Michigan in this listing, followed very closely by Indiana.

In the *Economic Record* of the National Industrial Conference Board for September 1942, values of war contracts were also classified on the basis of the 33 "industrial areas" set up by the U. S. Census Bureau. Furthermore, NICB has given us some interesting comparisons between the percentage of war contracts for each industrial area and the percentage of value added by manufacture as reported in the Census of Manufactures in 1939.

The Chicago industrial area, for example, received war contracts through June 30, 1942 amounting to 4.0 percent of the U.S. total but the same area in 1939 had produced 7.7 percent of the U.S. total value of products. In Cleveland the two figures were more nearly balanced—2.1 percent for contracts and 2.2 percent for manufactures. Contracts lagged behind production facilities in St. Louis with 1.2 percent as compared with 1.9 reported by the Census. The same situation applied in Milwaukee with 1.0 percent contracts and 1.5 percent manufacturers. Cincinnati with 0.9 percent contracts had 1.3 percent manufactures in 1939. Kansas City with 0.9 percent contracts had but 0.6 percent of manufacturers. For Minneapolis-St. Paul both percentages stood at 0.8. In Indianapolis contracts of 0.8 percent exceeded manufactures of 0.6 percent but in Akron and in Dayton the reverse situation showed with contracts 0.5 percent and 0.4 percent respectively, and manufactures standing at 0.7 percent for both cities.

The Chicago industrial area led the nation for war plant facilities with $962 million through June 30, 1942. Detroit was second with $572 million. St. Louis was in sixth place nationally with $299 million. Louisville, Ky., not included in the census division of "industrial areas," had new war contracts through June of $254 million which is only slightly less than that for metropolitan New York.

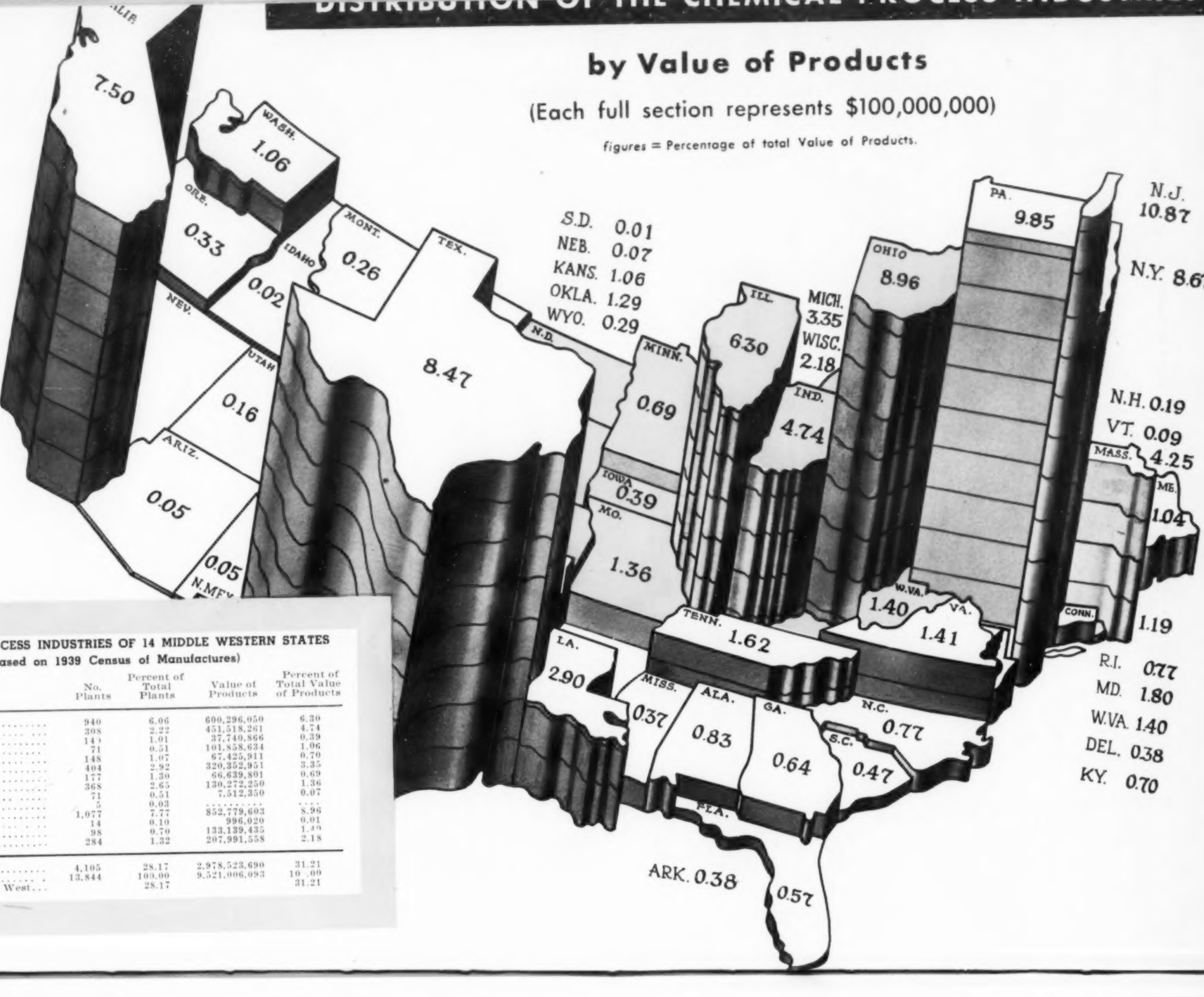
So it goes. The Middle West has become in a very true sense the arsenal of democracy as well as the granary and the butcher shop.

DISTRIBUTION OF THE CHEMICAL PROCESS INDUSTRIES

by Value of Products

(Each full section represents $100,000,000)

figures = Percentage of total Value of Products.



CHEMICAL PROCESS INDUSTRIES OF 14 MIDDLE WESTERN STATES
(Based on 1939 Census of Manufactures)

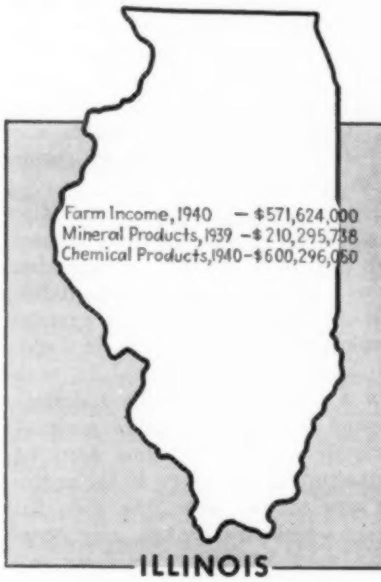
State	No. Plants	Percent of Total Plants	Value of Products	Percent of Total Value of Products
Illinois	940	6.06	600,296,050	6.30
Indiana	308	2.22	451,518,261	4.74
Iowa	14[illegible]	1.01	37,740,866	0.39
Kansas	71	0.51	101,858,634	1.06
Kentucky	148	1.07	67,425,911	0.70
Michigan	404	2.92	320,352,951	3.35
Minnesota	177	1.30	66,639,801	0.69
Missouri	368	2.65	130,272,250	1.36
Nebraska	71	0.51	7,512,350	0.07
North Dakota	5	0.03	....	....
Ohio	1,077	7.77	852,779,603	8.96
South Dakota	14	0.10	996,020	0.01
West Virginia	98	0.70	133,139,435	1.40
Wisconsin	284	1.32	207,991,558	2.18
Total for 14 States	4,105	28.17	2,978,523,690	31.21
Total for U. S.	13,844	100.00	9,521,006,093	100.00
Percent in Middle West		28.17		31.21

Resources and Manpower of the 14 Middlewestern States

BECAUSE so much of the future growth and development of the chemical process industries of the Middle West is dependent upon chemical engineers, we have turned principally to the educational institutions for the articles that follow. We have asked the heads of the various departments of chemical engineering to survey quite briefly those mineral and agricultural resources that are likely to be of most interest for industrial exploitation. To this extent their contributions bring up-to-date the more extensive series of regional surveys that appeared in Vol. 34 of *Chem. & Met.* beginning with the January 1927 issue.

Anyone who cares to review those articles of 15 years ago and to contrast them with the current summaries will be struck with the tremendous changes that have already resulted from the decentralization and diversification of the chemical engineering industries. To project your thinking that far into the future is a difficult but stimulating adventure!

But, as noted elsewhere in this Middlewestern issue, "resources without resourcefulness" are of little avail. So we have also asked our authors to discuss the question of technical manpower—to tell us something of the production facilities and the present and prospective market for chemical engineers in the various states of the Middle West. If these brief summaries prove of interest and lead to further study of the opportunities they represent, both authors and editors will have reason to feel that their joint efforts were worthwhile.



By HAROLD VAGTBORG

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THE STATE OF ILLINOIS has been described by a prominent military authority as one of the four most important industrial centers of the United States. The man who expressed this opinion may have been speaking not only of its present industrial production, but also of its promise of future development and its strategic location. Chief among its industries are chemical manufacturing and the closely related industries of steel manufacturing and the processing of petroleum and agricultural products.

Illinois is well placed geographically for future expansion in the chemical fields. Water and railway transportation are ample. Railway systems converge at Chicago, from the agricultural sections of the west and south and from the industrial areas of the east. Important from the military standpoint, a factor influencing the location of new industries today, is the fact that it is cut off by mountain ranges from both seacoasts and is well inland. Also important is its already well established industrial and civilian demand for chemical products within its own metropolitan area.

Illinois is fortunate in the natural resources upon which chemical industries depend: agricultural products, petroleum, coal and minerals. It has an abundance of these materials to meet the demands of increasing chemical manufacture. In addition it is near the grain fields and cattle grazing regions to the west.

A growing chemical industry demands ample supplies of power and fuel, which Illinois coal regions provide; of water, which exists in abundance in Lake Michigan and in the rivers of the state; of raw materials, already mentioned; of steel, available in the South Chicago mills; of skilled manpower, which is being trained in increasing numbers in a number of institutions of the state. There are, in addition, the research facilities of educational institutions, of an industrial research institute and of the Northern Research Laboratory of the U. S. Department of Agriculture at Peoria.

The program of training manpower is expanding to meet the needs of the chemical industries and unless seriously delayed by the military requirements of the nation, should be able to supply the future needs of the industry. The educational programs at Illinois Institute of Technology, the Universities of Chicago and of Illinois, Northwestern Institute of Technology and many smaller institutions show a definite increase in the demand for courses in the fields of chemistry, chemical engineering, and related subjects. There is at the present time a shortage of manpower in several fields, a situation created by the war and likely to become worse before it is corrected, but it is believed that in the long run the need will be filled by the educational facilities now available.

The chemical industries of Illinois are located largely in the Chicago, East St. Louis, Peoria, and Decatur areas. The latest available figures of the Census of Manufactures for 1939 indicate an annual output of $304,841,094 for the Illinois chemical industries. The output of the allied

petroleum refining industry was more than $120,000,000 in the state.

In the Chicago metropolitan area, which includes portions of neighboring Indiana, the chemical industries form the fifth largest industrial group, running ahead of petroleum refining. It is notable that in this area the leading industry is steel which is also closely related to the chemical industry, both in its methods and as a producer and consumer of chemicals. Important divisions of the chemical industry are based on the byproducts of the meat packing industry and of agricultural products and byproducts of food processing industry.

The trend of recent years accented by the war has been toward motor fuels of ever higher octane number. The war's demands for airplane fuels have speeded the conversion of refineries to the production of these types of gasoline. The return of peace will see the production of vehicles on a wide scale, whether automobiles or planes, which will use these types of fuels. The petroleum refineries of the Illinois area have ample steel capacity at hand for their needs for plant expansion or conversion. In addition Illinois has become a leading state in the production of petroleum within its own borders and the petroleum industry of the state holds an advantage from its being near a large source of supply. While Illinois has long been an important processor of petroleum because of its central location in a consuming area, the fact that it has also recently become a leading state in the production of petroleum has given it an additional advantage in the field.

The automobiles of the future will, we are told, have lighter bodies due to the greater use of plastics and aluminum and will be shod with tires of synthetic rubber. An important ingredient of plastics is furfural derived from agricultural byproducts in the development of which Illinois has led. It found its first large use because of its selective solvent properties in the refining of lubricating oils and is currently being used in the purification of butadiene. Formaldehyde, another important constituent of synthetic resins is produced from methanol which, in turn, is produced from carbon dioxide and hydrogen byproducts of fermentation.

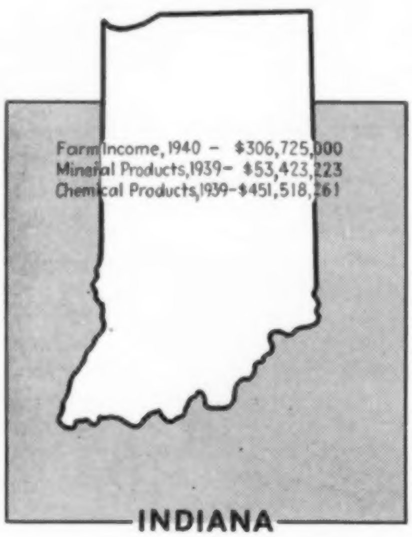
Synthetic rubber, while assured of a large place in our future economy, provides a puzzle with all of whose phases we are not yet familiar. Illinois chemical industries stand in a favorable position if it is to be produced from alcohol. This is the second largest corn producing state and is sufficiently near to Iowa which holds first place. If the synthetic rubber of the future is produced from petroleum, Illinois has large facilities at hand, as previously mentioned and may become an important factor in the industry.

The gas industry of the future will provide for the manufacture of gas at the coal mines with large pipe lines to convey it to metropolitan centers. With its coal resources, Illinois may well supply its share of manufactured gas.

The large facilities for the manufacture of explosives within the state and the expected large use of wheat in place of corn in the manufacture of starch are two factors in the war period production, the effect of which on post-war developments is questionable.

Other trends worth noting for their future development in the Illinois area are: the production of dextrose from corn, the use of corn as a starting material for the production of other new chemicals like butylene glycol and levulinic acid, the use of byproducts of the packing industry for the production of pure fatty acids and derivatives and otherwise.

Perhaps the most promising factor in the situation of the chemical industries of the area is the forward-looking attitude of many of the leaders of the industries. There are many plans for expansion of facilities and for production of new products which are far advanced in their experimental stage and await only the end of the war to permit their execution.



By J. L. BRAY

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For the past 30 years the center of population of the United States has been in Indiana, at the present time being near Linton in Green County. During the same period, the state has been transformed from one devoted principally to the raising of agricultural products to a highly industrialized section of the country. This development has come about through a unique combination of geographical, political, industrial and educational factors.

One factor involved is that of cheap fuel, because the state is crossed by a number of major oil and natural gas lines, which furnish not only very cheap fuels but, in the case of natural gas, one greatly desired in chemical and metallurgical industries, because of its purity and high heating value. Furthermore, Indiana has over 6,000 square miles underlain with coal. In recent years the production of coal has run around 20 million tons per year, about 30 percent of which comes from stripping operations. At present there are about 190 shafts and 55 strip mines, employing some 14,000 miners.

The proximity to Great Lakes also brings about a less rigorous climate than prevails in the neighboring states. It is obviously a great industrial advantage to have an average temperature of 28.4 deg. F. in January, and of 75.7 deg. in July, with only a moderate rainfall. Indiana's unusual topography makes most of the state adapted to some form of agriculture or industry. In the northern and central parts, the wide flat plains which are broken only occasionally by low ridges or river valleys, are attractive from an industrial standpoint.

Indiana is also fortunate in having excellent transportation, represented not only by six systems of railroads serving the state (with 6,954 miles of tracks), but also by a network of recently constructed roads totalling 76,000 miles, with over 9,000 in hard pavement. Indiana has the exceptionally heavy concentration of 1 mile of rails for every 5 square miles of land area. On its roads are operated approximately 120 truck lines. Furthermore, there is access to the cheapest transportation in the world on the last of the world's free seas—

the Great Lakes. In this connection it is worthy of note that cargoes may be carried on the Lakes a distance of 800 miles for 77 cents per gross ton, or less than 1 mill per ton mile. To move a ton of freight the same distance by railroad costs about $5. The importance of the Lake ports may be gaged by the fact that the annual movement of over 100,000,000 tons of cargo over the Great Lakes is more than the combined totals of all the Gulf and Pacific ports. Also available are the 600 miles of navigable rivers—the Ohio and the Wabash, which bring sulphur, molasses and oil to Jeffersonville, New Albany and Terre Haute; and the nearby Chicago Sanitary and Ship Canal which connects with the Mississippi River and Gulf ports.

The state has large areas of land devoted to agriculture (19,800,000 acres) represented by 190,000 farms. Much of this land is engaged in raising corn, grain and soybeans, which in turn are used in a great many chemical plants scattered about the state. A recent development is the planting of Russian dandelion, a raw material for synthetic rubber.

Another factor lies in the large reserves of man-power, as well as the character of this labor. The state has a population of about 3,500,000 (eleventh in the United States), only 105,000 of whom are foreign born. The remainder, something over 3,000,000 in all, are native born, highly skilled, well educated, and constitute an attractive reservoir for the chemical process industries. In this group, by reason of diversified industry, as well as a highly developed vocational training system, are found all the skills required by present day industry.

Indiana's constitution prohibits bonded indebtedness on the part of the state government, which has resulted in a much less extravagant spending program than has characterized neighboring states. The road system has been financed on a pay-as-you-go basis. By spreading the tax base into property, gross income and excise taxes, the state has greatly reduced the tax burden on property.

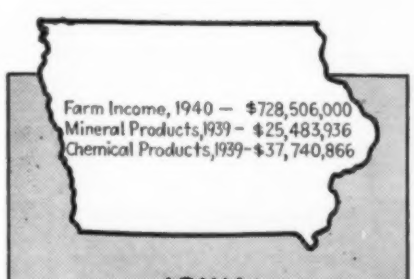
Years ago many distilleries were opened in the southern part of the state. These have since been consolidated into a few large companies which have adopted an aggressive research policy, with the result that even before the present emergency they were engaged in manufacturing industrial alcohol, solvents and allied products. Cheap corn, grain, and fuel, with molasses and sugar by boat from the south, are the raw materials used. The versatile soybean will also add to the variety and value of these products. Under the impetus of the present emergency these plants have been greatly enlarged and expanded.

The outstanding development within the state is, of course, the Calumet region along the shores of Lake Michigan, where there are many large plants devoted to the manufacture and processing of steel, oil, grain, soybeans, cement, etc. Gary, for example, possesses one of the largest steel mills in the world, Whiting one of the largest petroleum refineries and Buffington one of the largest cement plants (using waste slag from the steel mills). Other large industries produce sulphuric acid, refractory brick, coke, paint and glass. As a matter of fact, the manufacturing establishments within the state (3,904 in number, employing 350,000 wage earners) are highly diversified and include, besides those mentioned above, pharmaceutical products, automotive bodies and parts, railroad equipment, foundry and machine shops, hosiery, clothing, food and meat products, radios, bottles and fruit jars.

Indiana's school system has kept pace with its industrial development. In addition to one of the best school systems in the country, the state boasts two great state-maintained universities, two teachers' colleges and seven privately endowed institutions of higher learning. One of the state institutions, Purdue University (total enrollment 6,300) has the largest enrollment of engineering students in the country (3,600 in 1942) and a unique research organization, the Purdue Research Foundation, devoted to promoting research relations with industry.

There are many important munition plants scattered about the state. Some of these are expansions of old industries, but many have been recently built and are among the largest and most modern in the country. The character, location and size of these, for military reasons, cannot be discussed here. It is obvious, however, that the state, because of its central, and consequently well-protected location, as well as its enormous natural resources in the shape of natural gas, coal, oil, corn, soybeans, limestone, etc., offers an ideal location for such industries.

The future for the state, from a process industry standpoint, is bright indeed. On the one hand we have a rapidly expanding metallurgical district, backed up by the enormous iron ore resources of Minnesota and Michigan, and the cheap transportation of the Great Lakes. It is obvious that Gary was selected as a site for a steel plant because it occupies a strategic position between these ores and the fine coking coals of West Virginia, Pennsylvania and Kentucky. On the other hand we have an equally promising chemical industry involving the manufacture and processing of plastics, petroleum, alcohol, solvents and cement. Hand maiden to both of these will be hundreds of establishments consuming these products in the manufacture of machinery, airplanes, automobiles, etc. Furthermore, there are enormous resources of limestone and shale, which are suitable for the manufacture of cement, as well as clays and kaolin for the refractory and the structural brick industries.



By O. R. SWEENEY

Head, Department of Chemical and Mining Engineering, Iowa State College, Ames, Ia.

AGRICULTURALLY, it is possible to feed, clothe and house a denser population in Iowa than in any other spot, of similar size, in the world. Not only is adequate water available from streams, but a wide distribution of ground water makes it possible to obtain additional supplies by drilling almost any place in the state. While much of this water is fairly hard (11 to 21 g.p.g.), it is easily softened and is satisfactory for steam, cooling and chemical uses.

Intrinsically, the greatest asset of the state is its 55,586 sq.mi. of rich, well-drained, level soil. Twenty-five percent of all the Grade I farming land of America is within the state. The soil and subsoil are so rich in plant food that commercial fertilizer is unnecessary.

Corn is the first rank crop. The production for the current year will be 550,000,000 bu. Corn is processed into corn oil, protein stock feed, starch, corn syrup, corn sugar, and many other specialties in plants at Cedar Rapids, Keokuk and Clinton that are among the largest in the world. Since most corn is still used for animal feed, cattle, swine, sheep and poultry are produced in great numbers. Much of this livestock is processed out of the state, but a great and rapidly growing slaughter industry is in operation. From its byproducts there are raw materials for other chemical industries: bone, fertilizer, lard substitutes, and soap are examples.

The vast number of animals which die before they leave the farm are processed in local plants for hides, hoofs, horns, hard oils and tankage. Since the state is now producing quantities of soybean and corn oil, together with hard oil and off grade slaughter-house fats, there is a strong probability that the already sizeable detergent industry will expand.

Recently an industrial alcohol plant has been erected at Clinton to utilize the rehabilitated facilities of an abandoned brewery. Using grain as raw material, its output will include byproduct stock feed which will be fed to nearby livestock. Should synthetic rubber be produced on a continuing basis from grain alcohol, the state would be an ideal location for additional alcohol plants. Research has shown that corn can also be fermented to yield butylene glycol, which gives promise of producing butadiene rubber even more cheaply. (See *Chem. & Met.*, Oct. 1942, p. 95).

Soybean production for the current year will be 36,000,000 bu. This versatile legume can be processed into vegetable milk, cheese, oil, stock feed, lecithin, flour, soy sauce, plastics, adhesives, diabetic food, butter and rubber substitutes, soap, paint, linoleum, printer's ink, candles, salad oil, fly spray and lubricants. Twelve plants within the state process the beans into oil and meal. The belief is that numerous small plants dispersed throughout the state will be more economical than large centralized installations. The beans can be delivered to the plant and the bulky stock feed returned immediately to the farm with less transportation expense. The more valuable oil is less bulky and can be shipped more economically. Soybean processing seems to offer a splendid investment opportunity for chemical capital.

Perhaps the most attractive raw materials for chemical development are the great byproducts or residues of agriculture which are at present largely wasted. The stalks, cobs, straw, leaves, hulls and roots represent a much larger and concentrated tonnage than the concomitant grain. Already the industry is developing, but its exploitation is hardly begun. A large plant at Dubuque produces synthetic lumber from cornstalks. The world's pioneer and largest furfural plant is at Cedar Rapids. It has been estimated that if all the pentosan byproducts of agriculture in the United States were converted to furfural, the industry would have a 50 percent greater tonnage than the petroleum industry.

The well designed and efficiently operated cellophane plant at Clinton presently obtains its cellulose from wood. Should there be a shortage of this material at any time, the vast cornstalk supply could furnish an inexhaustible source of cellulose for this industry.

A sizeable and growing electrochemical industry is centered around the Mississippi River dam at Keokuk. This industry could be expanded there and elsewhere in Iowa. Other dams are now built in the Mississippi above the Keokuk dam and if the water supply is properly buffered, these dams may be used to furnish additional hydroelectric power. There are numerous other hydroelectric developments in the state and many good dam sites which can be developed.

Many coal-gas plants formerly served the state, but at present most gas needs are supplied by much cheaper natural gas brought in by pipeline from mid-continent oilfields. Six large cement plants have been built to use raw materials that are cheap and plentiful in Iowa.

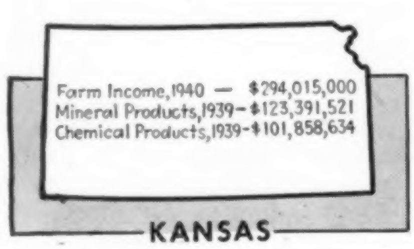
There are two beet sugar plants in the state but this industry can be readily expanded should America decide to supply the sugar needs within its own borders. The interesting sugar, xylose, can be produced to the extent of one-fifth the weight of the agricultural wastes. Levulose production has also shown great possibilities, but is still in the experimental stage.

Little lime is produced in the state, although the limestone deposits are extensive and there is a considerable consumption of lime for strawboard, water softening, building material and sugar refining. Good clay deposits are to be found throughout the state. Brick, tile and pottery are produced but the ceramic industry should be much larger to supply domestic needs. There are some bentonite-like clays which have not been well studied, but which show promise of industrial development.

The strawboard industry is centered at Tama with many plants nearby in bordering states. The supply of straw in this area is practically inexhaustible. It has been shown that cornstalks together with straw make splendid paper of both strawboard and higher grades. If necessary, Iowa could supply the country's entire "fiber-board" container industry with this important raw material.

There are two large deposits of gypsum in the state. At Fort Dodge the industry has become one of the largest in the country. Wallboard, plasterboard, blocks, cement retarder, Keene's cement, partition tile and insulation material are produced in quantity. Other gypsum deposits at Centerville have not been worked as yet.

In summary it can be stated that although a sizeable chemical industry is already flourishing in Iowa, the raw materials, power, labor, and transportation facilities are favorable for a much greater development in the future.



By W. L. FAITH
Department of Chemical Engineering
Kansas State College, Manhattan, Kan.

KANSAS is particularly fortunate, from the standpoint of the chemical process industries, in having a sound balance between agricultural and mineral raw materials. For a number of years the state has supplied industry with petroleum, natural gas, coal, salt, gypsum, lead, zinc, grain, fats, oil-seeds and other raw materials. Although Kansas has long been considered an agricultural state, its industry has been growing slowly, and in 1940, the value derived from industrial products finally

exceeded the value returned to the state from farm products. The state now has war contracts aggregating over $1\frac{1}{2}$ billion dollars. Included are several large chemical units.

It comes as a surprise to many that Kansas ranks eighth in the nation in the value of total annual mineral production. This includes a wide variety of minerals.

Coal—Bituminous coal underlies a large area of eastern Kansas, but about 70 percent of present production comes from the southeastern Kansas field. Annual production has been as high as 7,500,000 tons. The coal is non-slaking and carries some pyrite, which is removed by washing, forming a valuable byproduct, inasmuch as all of it is sold for sulphuric acid manufacture. Tests under the auspices of the Bureau of Mines show that the coal is suitable for the production of chemical coke.

Petroleum—Sixth in the United States in the production of oil in 1941, Kansas has 27 refineries with a crude oil capacity of 175,800 bbl. per day. Several refineries are producing specialty products such as solvents of very narrow boiling-point range.

Natural Gas—Kansas has produced natural gas for over 80 years, present annual production being about 100 billion cu. ft. Wells exist throughout the petroleum producing area, and also in the huge Hugoton field in southwestern Kansas. Reserves in this field are estimated at $13\frac{1}{2}$ trillion cu. ft. of low cost gas. Fifteen natural gasoline plants with a daily capacity of over 300,000 gal. are in operation. Two plants in Grant and Haskell counties are producing carbon black and others are under construction.

Zinc and Lead—Kansas deposits of zinc and lead are part of the great Tri-State district which includes southeastern Kansas. There is a smelter at Galena, and at least two other plants manufacturing zinc and lead chemicals in the state.

Clays—In central and north-central Kansas there are millions of tons of clays with an alumina content varying from 28 to 32 per cent and smaller tonnages ranging from 32 to 39 per cent alumina, a potential source of alumina, of which 125 billion tons may be mined economically by stripping methods. This Cretaceous clay is also well adapted to the manufacture of structural clay products. Sixteen ceramic plants operate in the state.

Dolomite—Two deposits of dolomite in central and southern Kansas have an estimated reserve of 16 million tons obtainable by strip mining. This material and also oil-field brines running as high as 5,000 parts per million magnesium are potential raw materials for the production of metallic magnesium.

Salt—A large area of central and southwestern Kansas is underlain with a salt deposit attaining a thickness of 800 ft. in some places. Seven plants near Hutchinson, Lyons, and Kanopolis are producing 700,000 tons annually. Reserves are estimated at 5 trillion tons.

Gypsum—Workable deposits of gypsum are found in three separate areas, with two mills producing high grade gypsum products, and two operating mines.

Limestone and Shale—Unlimited reserves of limestone occur in the eastern portion of the state, much of which runs over 90 per cent $CaCO_3$. Large shale deposits lie in the limestone area, and six portland cement plants make use of these materials. Some of the limestone is well adapted to rock-wool manufacture, and plants are operating at Winfield and at Parsons.

Other Minerals—One plant in Kansas has been producing asphalt rock for several years. Known reserves exceed 25 million tons. Numerous bentonite deposits are undeveloped. Fifty million tons of chalk are suitable for mining by stripping methods. Diatomaceous marl reserves, unexploited at present, are estimated to be in excess of a million tons. Tripoli occurs in Cherokee County, and a processing plant is in operation near Baxter Springs. Kansas is the leading state in the production of volcanic ash, producing about 40,000 tons in 1940, with reserves of 10 million tons.

Water—The water supply of the state is of two general types, surface water in the east, and ground water in the west. Although the western portion of the state is commonly considered a comparatively dry region, 20 million gal. water per day is available for continued use in certain localities. Information in great detail is available from various state agencies.

FARM PRODUCTS

In production of farm crops, Kansas is one of the leading states. With changing food habits, and loss of export markets, agriculture must look more and more to industry as an outlet for farm products. Fortunately, industrial research is developing more uses for these inexhaustible raw materials, which in time must replace our depleted minerals.

Grains—Wheat has long been the Number One grain crop of Kansas, but production costs generally limit its use to flour manufacture. Of the other grains, only small quantities are used industrially although most of them are suitable for the manufacture of starch, glucose, alcohol, and various other solvents derived from starch. A newcomer which offers tremendous possibilities as a source of starch and derived chemicals is sorghum grain. Research at Kansas State College on this drought-resistant crop is now approaching the pilot plant stage and has shown that starch may be produced in high yields from this cheapest of all starchy grains. A protein feed and sorghum oil are obtainable as a byproduct. Some varieties yield a starch practically identical with tapioca; others a starch resembling corn starch; others fall between these two.

As a raw material for alcohol production, the grain sorghums may prove superior to other grains, because of low production costs. A plant at Atchison has been producing alcohol from such grain for several years.

OTHER PRODUCTS

Other Products—Kansas grows flax and soybeans which are utilized at plants in Fredonia, Emporia and Atchison for vegetable oil production; other are contemplated. A beet sugar refinery at Garden City has an average annual production of 10,000 tons. Exceptional facilities exist in the Kaw River valley area for the growing of sweet potatoes for industrial use. A number of plants dehydrate alfalfa for high vitamin feed, and wheat and oat grass for food. A plant at Hutchinson manufactures strawboard.

In meat packing, Kansas City, Kan., is second only to Chicago, and two large and several small soap and glycerine plants utilize the byproduct fats, while other small plants process other byproducts in making pharmaceuticals, glue, fertilizers, etc.

Labor relations in Kansas have always been extremely satisfactory. The population is 96.3 percent white, of which 97.3 percent is native born. Over 85 percent of the persons over 25 years of age or older have completed the seventh grade, according to the 1940 U. S. Census.

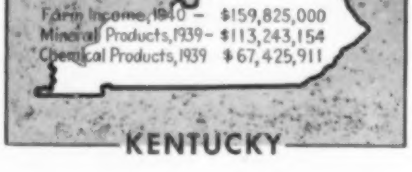
Transportation facilities of all types are available throughout the state. Eight major trunk line railroads operate in Kansas, and an ex-

cellent highway system gives access to any locality in the state.

Various groups in Kansas, particularly the Kansas Industrial Development Commission and the Technical Committee of the State Chamber of Commerce have been active in planning for post-war industrial expansion. Geography has given Kansas a strategic location second to none in our war economy and equally important in the post-war period. Wichita manufactures daily more planes than any city in the United States. In a post-war economy this industry will require large quantities of plastics, solvents, light metals, rubber and heavy chemicals. A war plant now producing ammonia can manufacture urea, which together with organic chemicals from petroleum and natural gas, cellulose derivatives manufactured in another war plant, and tons of cheap fillers can form the basis of a plastics industry.

The necessary chlorine and alkalis are logical products from an inexhaustible salt supply. Natural gas offers a cheap source of power and water is abundant. The grain sorghums are an ideal raw material for alcohol manufacture and practically every item needed for any kind of synthetic rubber may be produced cheaply from local raw materials. Flax, soybeans, and other oil-bearing-seed crops can easily furnish needed drying oils.

Probable changing food habits will demand larger quantities of dehydrated foods and grasses. More plants processing animal products can be utilized, and a brand-new starch industry based on grain sorghums is practically certain. Present ammonia facilities can produce sufficient material to be combined with phosphate rock to form the basis of a much needed fertilizer industry. Further possibilities based upon the agricultural, mineral, and human facilities of Kansas are being studied, and industry will find the state willing to grant it more than the proverbial "half-chance."



By R. C. ERNST
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INDUSTRIAL HISTORY of Kentucky is in the making and affords a promising field for the chemical engineer. In past years it has been considered primarily an agricultural state. It is now rapidly utilizing its abundant and diversified natural resources and geographic position to assume a more balanced and more decisive economy.

The natural advantages of Kentucky are numerous. Strategically located immediately south of the center of population of the entire nation, it affords splendid opportunities for the distribution of its mineral and agricultural resources as well as for its manufactured products. A glance at a map of the United States will show Kentucky's position contiguous to the vast agricultural regions of the South and Middle-West with their demands for finished goods of all sorts; and at the same time Kentucky's nearness to the heavily populated centers with their possibilities of market and transportation.

Yet ideal geographic position is but one of the important factors in Kentucky's industrial development. The principal mineral resources of the state are its abundance of fuels. Kentucky ranks fourth in bituminous coal for the United States, and fields are located in both the eastern and western sections of the state. Furthermore, oil and natural gas are available in quantities large enough to meet all the requirements of expanding chemical and manufacturing industry.

In addition to the foregoing sources of energy, mention should be made of the four hydroelectric developments, not including Gilbertsville Dam, which coordinate with 39 steam and gas generating plants to supply adequate electrical power for the state's expanding manufacturing industries.

The mineral resources of Kentucky include limestone, which is found in large quantities throughout the state, and the deposits of fluorspar, ball clays and rock asphalt rank Kentucky first in the nation. The supply of timber is adequate for a flourishing furniture and a future plywood, paper pulp and rayon industry. The raw material resources are handled by a transportation system of nine major railroads and four navigable rivers, of which the Ohio is the most important.

Manufacturing in the state is, in general, concentrated on its waterways, especially the Ohio river. This section is in a very favorable position on the border of the official and southern zones, its distilleries are well known throughout the United States. The state contains five of the largest plants of their kind in the world. These include the manufacture of cast iron sanitary ware, the milling of soft winter wheat, the production of rock asphalt, the manufacture of light-gage non-ferrous metals and the forging of steel valves. Other larger manufactures include steel mills, a third ranking in paint and varnish products, sizable tobacco products and byproducts and furniture and wood products industries.

The war program in this area is important. Many of the new plants, such as those devoted to aluminum and steel fabrication, are expected to remain as post-war industries. The geographic, transportation, and raw material advantages are vital in this consideration. But favorable labor conditions with the high percentage of native-born workers, have had important bearing.

To enumerate only a few of the industrial projects in Kentucky will illustrate that state's part in the production of war materials. At Ashland has been completed one of the largest blast furnaces in the world. This construction, plus the added plant capacity at Covington, means the further development and expansion of the steel industry, and insures its corollary, the continued position of coal mining as the principal industry of Eastern Kentucky.

The new synthetic ammonia plant at Henderson presages the development of an expanded fertilizer industry, in close conjunction with phosphate and sulphuric acid industry of Tennessee. Government ordnance works are located in nearby Indiana and at Paducah and Richmond.

In the Louisville area rapid expansion of at least one company would indicate a sizeable light-metal alloys industry after the war. The recent establishment of a cargo plane plant in this area is an indication of future freight transportation. Another significant addition has been the opening of the synthetic rubber industry in this area. Several plants for carbide and butadiene production, contribute raw materials to a number of polymerization plants in

Kentucky and elsewhere. Taken together, these vast industrial efforts represent a fundamental rearrangement of economic life.

The distilling industry is cooperating in the defense program in making its products available as industrial alcohol and one of its members is studying pilot-plant production of butadiene from farm products.

The diversity of the new industries and the abundance of mineral and agricultural resources together with its ideal geographic location and mild climate, would indicate that Kentucky will be prepared for a balanced post-war industrial development.

It is interesting to note how industry in the past flourished in a direct relation with agriculture. The chief agricultural product is tobacco, ranking second in the entire country, and Kentucky is conspicuous for its cigarette and tobacco factories. Corn is the second ranking product; and the state has long been recognized for its 40 distilleries which produce 40 percent of the nation's whiskey. The agricultural area extends throughout the central part of the state. Cattle and dairying, in conjunction with corn and tobacco, have made central Kentucky one of the wealthiest agricultural sections to be found anywhere in the United States.

Kentucky offers unusual opportunities for the chemical engineer. Fundamental raw materials are easily available, and the modernization and expansion of its industries have been considerable. The development of new and important products in nonferrous and ferrous metals, rubber, paint, distilleries, tobacco and agricultural products and byproducts, affords a real challenge to his skill and energy.

MICHIGAN

By **ALFRED H. WHITE**
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Michigan has just entered its adult period of industrial vigor. It is surrounded on three sides by the navigable waters of the Great Lakes. Main East and West railroad systems pass through its southern counties. The climate is conducive to vigorous work. Perhaps most important, its people retain the attitude of the pioneer and are eager to tackle new problems.

The iron ore from the Lake Superior district is floated through the Detroit river on its way to the steel mills of Ohio and Pennsylvania. It has been shown to be logical and economical to erect similar plants along the Detroit river and great plants have been erected there catering especially to the automobile industry. The copper mines of the upper Peninsula are not preeminent as they were once, but are still important. Petroleum and natural gas resources are not large as compared with Oklahoma or Texas, but are of considerable size and are being developed wisely.

The chemical industry started two generations ago with the raw materials of lumber and salt. The lumber has largely disappeared, but the salt is still abundant and has become a raw material for great chemical plants which, originally making soda ash as the chief product, progressed to caustic soda and chlorine and have in this last generation developed the manufacture of plastics and complicated organic chemicals, using salt as the local raw material. The furniture industry grew up in Grand Rapids because of the lumber. Pulp mills sprang up in various parts of the state, and the manufacture of paper became an important industry in Kalamazoo because of the favorable conjunction of wood, water and shipping facilities. The alkali industry developed around Detroit because of the pure salt deposits. The Dow Chemical Co. started at Midland because of the unusual composition of the brines there. But the breakfast food industry of Battle Creek and the automobile industry of Detroit did not owe their growth to any extraordinary local resources. They started and grew because of the energy and vision of many men, including the often maligned group of the bankers. Each successful industry brought others. Blast furnaces, coke ovens, steel mills, copper and brass fabricators, glass plants, tire factories, synthetic resin plants and a host of others supplying materials for the automobile industry have built up a vast metropolitan area around Detroit, with subsidiary centers in most of the other cities of the lower peninsula.

The United States Census of Manufactures places Michigan in its East North Central group with Ohio, Indiana, Illinois and Wisconsin. These five states produced 31 percent of the value of all manufactured articles of the United States in 1939. The Middle Atlantic Section, consisting of New York, New Jersey and Pennsylvania, accounted for an additional 28 percent. These eight states stretching from the New York to the Chicago area produced 59 percent of the value of the manufactured products of the United States in 1939. Individually these states are all in the first ten in value of manufactured products, the other two states being California in seventh place and Massachusetts ranking eighth.

The decade following the financial crash of 1929 saw many readjustments in the industrial world. Recovery came more rapidly and in greater measure to those localities which had natural advantages and were prepared to take advantage of them. The extent of the redistribution of manufacturing facilities is indicated by the figures for power consumption in various parts of the country. The census figures for 1939 show that each of the states east of Ohio had less installed capacity of prime movers in 1939 than in 1929. Ohio itself had slightly less, Illinois slightly more, Indiana a rather small increase of 72,000, while Michigan had an increase of 632,000 installed hp., over 60 percent above the 1,005,000 hp. existing in the state in 1929. This one state is to be credited with over half of the increase in installed horsepower in the United States during the decade of the depression.

The census figures have no data later than 1939 and so do not reveal the tremendous changes that have come to the state through its participation in the war effort. The industrial leaders of the state acted promptly and daringly. Not even the residents of the Detroit area have much conception of the magnitude of the new plants that have been built. The smaller industrial cities of the state have also converted their industries to war work, and even the furniture factories have become active in making plywood and wood structural members for light planes and gliders.

The relative youth of Michigan as an industrial state has been an asset. Its leaders were not hampered by tradition and were rather scornful of old methods. Henry Ford expressed this attitude in his statement made many years ago: "If it has been done that way for one hundred years, then it must be wrong." Some of Michigan's industrial pioneers, like Dr. Herbert Dow, were well trained engineers who took no steps without a study of the scientific background. Most of the pioneers were vigorous men who knew what they wanted to accomplish and were willing to spend money freely to accomplish it. They were quick to appreciate the necessity for trained technical advisers and surrounded themselves with young scientists and engineers who were told to get things done. With that stimulus and with adequate financial backing, things happened. Some of these attempts were mistakes which might have been avoided by more careful study, but on the whole progress was extremely rapid.

The post war position of Michigan will be that of a highly industrialized state which has converted its manufacturing industries almost wholly to the war effort and must shift them back to the old or to new operations if it is not to lose some of its prosperity. The tide of industry has been away from the Atlantic seaboard during a generation. It is still swelling in the region of the Great Lakes and the Eastern Mississippi River valley. Michigan will resume its preeminence in the automobile industry and will be prominent in the manufacture of airplanes. Those two industries will continue to call for an extraordinary variety of materials, old and new, which can be manufactured advantageously close to the point of assembly. There will be many new factories with excellent power and shipping facilities which can be purchased from the government at a fraction of their cost. New housing facilities have been erected adjacent to many of these plants so that the state can care for more workers than in the prewar period. Michigan still retains its advantageous position near to the center of population of the United States and with unrivaled facilities for transportation by both water, rail and highway.

The future may be difficult, but the energetic managers, engineers and scientists who built up the industries of Michigan during the last generation and have converted them so brilliantly to war purposes can be relied on to meet the problems of the post war period. Michigan will still be a leader in the industrial world, not only because of its material resources but also because of the skill and energy of those who guide its industries.

By CHARLES A. MANN

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THIS STATE has a limited variety of natural resources, but the few it has are plentiful and of considerable importance to chemical engineering industries. Iron ore is probably the outstanding natural resource of Minnesota, which supplies 60 percent of the ore used in the United States. Yet there still remains in the ground 1,000,000,000 tons of high-class ore, 1,300,000,000 tons of low-grade ore which can be beneficiated and enormous qantities of taconite ore. Much of the iron ore is manganiferous.

During 1942, about 90,000,000 tons will have been shipped to the various blast furnaces. There are only two pig iron and steel plants in the state, located in Duluth. Slag from the plants is converted into Portland cement. Beneficiation of the low-grade ores has been carried on to make these available for immediate use. Manganese likewise has been recovered by the Bradley process on a pilot plant scale. Efforts were made without success to have two manganese recovery plants established on the iron ore range.

Peat located in 25 counties is estimated at 7,000,000,000 tons, which is 50 percent of the nation's total. None of this has been developed for fuel purposes and only small amounts are used as fuel in local communities. It has been claimed that iron ore can be successfully reduced with peat. Some peat is used for soil conditioning, packing perishable goods, insulation material and mainly as litter. It seems as if this low-grade fuel could be developed and the peat converted into many useful industrial products.

Minnesota leads the world in variety of granites. It ranks third among the states in production of this stone for building and monumental purposes. In 30 counties are found enormous deposits of limestone and particularly marl. Much of the limestone is very high grade and is used as a building stone and as crushed rock for road work. It is available for cement manufacture and for making rock wool, as soil conditioner and in the beet sugar industry. Marl has not been used very extensively, but it is suitable for making cement.

There is a considerable amount of valuable clay in Minnesota which is used for making bricks, sewer pipe and furnace refractories. Some of this clay is satisfactory for making stoneware products and others for making oriental pottery. There is also a limited amount of clay suitable for making chinaware. Still another mineral is the feldspar which is being used for glazing purposes and one or two plants are using it with lime to make rock wool. Enormous quantities of fine-grained, white glass-making sand are also plentiful. This has been used by a large plate glass manufacturer.

The forests of Minnesota have supplied the lumbering industries with large amounts of wood, but there still remains two-thirds of the forest land area that has good stands of pine and hard woods as well as pulp woods. Minnesota is the leading pulp wood state among the Lake states. It has been estimated that there are 19,000,000 cords of high-grade pulp wood and about 15,000,000 cords of a lower grade, including spruce, balsam fir, jack pine, aspen and tamarack. More and more jack pine and tamarack are being used for pulp and paper making.

Though aspen is usable for lumber, it can be used to produce high-grade alpha cellulose by a nitric acid process developed at the University of Minnesota. This is now in pilot plant operation. The aspen tree is a fast grower, so that the annual supply amounts to 1,807,000 cords. Two large pulp and paper plants are now located in Minnesota and experimentation is going on to utilize their sulphite liquors. Insulation material in

the form of balsam wool is produced in large quantities as is also insulation board, press board, wood flour fillers for plastics, linoleum and similar materials.

A number of agricultural products are of importance for the chemical and food industries. Flax seed production of Minnesota is two-thirds of the total American production. Up to the present, 45,000 tons of tow are produced annually, though 225,000 tons could be produced. This is used for making rugs and recently has been shipped out of the state for the manufacture of cigarette paper. Nothing has been done with the shives which should be a useful raw material.

Minnesota flax is grown mainly to obtain high oil yields. Nothing was done about recovery of the fiber until this last year when it was found by the chemical engineering laboratories that a high-grade linen thread can be obtained for weaving cloth.

Linseed oil production amounts to $13,300,000, which places Minnesota first in the United States. Wheat and potato production rank third and seventh respectively in the United States. These materials are available not only for food purposes but for the manufacture of alcohol. Soybean is produced in relatively small amounts but soil and climatic conditions are satisfactory for the growth of this farm product. Sugar beets are grown in Minnesota, with two plants producing the beet sugar.

Milk production in Minnesota is very high. A number of plants are producing dried skim milk at $3,200,000; whey powder valued at $512,000 and dried casein worth $1,300,000. Most of this casein is used for feeding purposes though some effort has been made to produce a quality of casein suitable for making glue, cold water paints and particularly for making casein wool. There is every indication that casein production can be increased materially.

Operating personnel of plants manufacturing industrial chemical products includes a considerable number of trained chemical engineers. Many of the plants could use more chemical engineers and some of them who have no engineers on their staffs could well use some. In many respects, Minnesota is rather backward in making full use of these trained men. The result is that graduates of chemical engineering at the University of Minnesota accept jobs out of the state. Actually this would leave a shortage for the manufacturing establishments, particularly if these realized the importance and desirability of the chemical engineer. This is especially true as regards the development of new products. One example of this situation is as follows: It was proposed to manufacture casein wool in Minnesota where the raw material is readily available. No man experienced either in making good casein or converting it into the wool is available either in Minnesota or in nearby states. If the demand for chemical engineers were greater locally, the industries could be supplied by young but inexperienced graduates from the Chemical Engineering Department of the University.

By HARRY A. CURTIS

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A FEW YEARS AGO we had all the iron and aluminum and rubber needed to fight a war. In fact at that time we had most everything required except, as it now appears, a vision of what the morrow would bring forth. It was conceded even then that a few more ammonia plants might be required and maybe a few TNT and smokeless powder plants. The ammonia plants must be built in the eastern part of the country, however, and only by the few concerns having the sacred "know how." As one brass-bebuttoned gentleman patiently explained, ammonia plants could be built only where West Virginia coke was available. And a certain TNT plant could be located only in Ohio, because only there could an outlet be found for spent acid.

Times have changed remarkably. Even Missouri has an ammonia plant now, and many another inland state is no doubt surprised to find itself the location of manufacturing plants which, in the good old days, just had to be located elsewhere. Some of these states are now wondering if they haven't believed too long and too naively in some "West Virginia coke" mystery. At any rate, they are taking stock of their natural resources, their human resources, their potential markets. It seems not too much to hope that some of the plants born of war requirements may survive as the nuclei of industrial centers.

Missouri has long had a considerable chemical industry, some of it, to be sure, on the Illinois side of the Mississippi at St. Louis. In his article of 1927 (*Chem. & Met.* **34**, p. 36) Cuno listed twenty-odd chemical concerns in the St. Louis district. He omitted one old and famous chemical concern which markets its excellent product in bottles and kegs and barrels.

Cuno gave a long list of chemicals produced in the district, but remarked that "a large proportion of both heavy and refined chemicals is still being obtained from producers outside the district." He also remarked that "approximately one-third of the fine chemicals and medicinals used in the United States is distributed from this district." In general, this characteristic of the St. Louis chemical industry has remained unchanged, i.e. it manufactures considerable quantities of heavy and refined chemicals for its own use, but brings in still greater quantities; it ships out principally fine chemicals and medicinals, along with a great variety of products in the manufacture of which chemicals were consumed. In other words, St. Louis is a chemical manufacturing center not primarily because of location near raw materials but because of a remarkably favorable location with respect to transportation.

Looking toward the future, it may be expected that the favorable factors which have combined to make possible a chemical industry in St. Louis will permit a normal expansion of the type of manufacturing already established there. Along this line it may be noted that some of the chemical manufacturing concerns in the St. Louis area already have complementing plants elsewhere from which some of the semi-finished products are shipped to their St. Louis plants. As an example of this there may be cited the Monsanto Chemical Co. which built a large phosphate smelting plant in Tennessee a few years ago and thus assured the company of a supply of phosphorus under its own control, and in turn permitting the company to enter or increase the

production of phosphorus containing chemicals in its St. Louis operations.

St. Louis is not the only town in Missouri where chemical plants may be found, as the chambers of commerce in any one of a dozen or so other towns will readily testify, but at present only the St. Louis district may claim to be a chemical manufacturing center of any considerable importance.

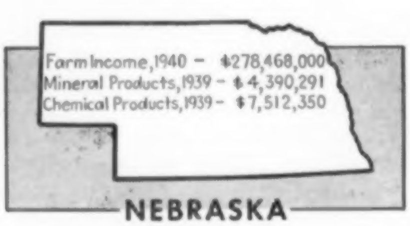
The natural resources of Missouri are by no means fully utilized within the state as yet. Missouri leads the states in production of crude barite and of lead; in 1940 the crude barite production amounted to 390,460 tons, and the recoverable lead to 169,500 tons. The zinc production in 1940 was 14,000 tons, which is less than 6 percent of the total for the Joplin district as a whole. Silver production amounted to 260,000 fine ounces. In 1936 coal production was 3,985,000 tons. Since 1936 the Missouri coal production statistics of "Mineral Industry" have been merged in the Kansas-Missouri-Oklahoma total. In 1940 there were 94 wells drilled for oil in Missouri, of which 5 are now classified as oil wells and 30 as gas wells. Oil production amounted to 40,000 bbl.

One rather striking example of an industry whose location was fixed by raw material supply is that of the superduty firebrick production in the neighborhood of Mexico, Mo. From the plants in this area very high grade fireclay brick and shapes are shipped all over the United States and into several foreign countries.

A considerable amount of hydroelectric power is potentially available in the Ozark region of Missouri and some has been developed. Construction of federally owned dams was halted by the war program but presumably will be resumed at some later date. If this power development and distribution can be handled in some such fashion as in the Tennessee River basin, there will be opportunity for an electrochemical industry based on relatively cheap hydroelectric power.

What promise, if any, the farm chemurgic idea may hold for the future is not yet clear. Farm grown crops have long been processed for products other than foodstuff, but not on any such scale as visualized by even the most conservative of the farm chemurgic folks. It seems likely that some few non-food products may, indeed, come to be made in large quantities from farm crops. If, for example, the alcohol to rubber process eventually proves economic, an industry of considerable magnitude may develop around this process. Missouri is favorably located for such an industry.

Two of Missouri's best known exports are mules and engineering graduates. Only a small fraction of the technical graduates of Missouri colleges and universities are able to find attractive employment within the state. Of the 21 chemical engineers who graduated at the University of Missouri last June, all are employed but not one within the state. The same is true of the graduates in electrical engineering and, with but few exceptions, of graduates in civil and mechanical engineering. An expansion of manufacturing of any sort would not be hampered by lack of men with technical training.



By C. J. FRANKFORTER
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THIS STATE does not have the natural resources which have brought millions of dollars and people to certain other regions. However, it does have some resources and may have what will prove to be others when industrial and technical developments proceed normally again.

Mineral resources are somewhat limited but salt, gypsum, limestone, shale, clay, granite, sand, gravel and pumicite with a bit of coal, exist in various sections of the state. However, at present it is not economical to produce some of these materials.

A number of brick plants manufacture a good quality product and two cement plants normally produce about 5,000 barrels daily. These are now working over-time. Huge quantities of sand and gravel are available and many tons go into concrete and on gravel roads.

One plant markets a large volume of carefully graded pumicite or volcanic ash, which goes into various abrasive and cleansing powders. Oil has been discovered in southeastern Nebraska and there are indications that it may be found elsewhere in the state. At present there are 45–50 producing wells, yielding 25–700 bbl. per day. In 1941, more than 3,775,000 bbl. were produced from an average depth of 2,200–2,300 ft. This crude is a mixed base oil yielding little in the motor fuel boiling range but giving a goodly fraction in the distillate and diesel fuel ranges. Much of the oil is now used directly as fuel. Some is topped to yield light furnace oils, the reduced crude going as heavy fuel oil. If the wax can be economically removed, a good grade of road oil can be marketed.

In agriculture, Nebraska ranks high. The state suffered severely during the drought years and two years ago an unusually early and heavy freeze killed many fruit trees. The state did have quite a dust-bowl. However, agriculture and associated industries are definitely and rapidly coming back.

Irrigation of some 600,000 acres in middle-western and western Nebraska makes certain good yields of sugar beets, alfalfa, potatoes and certain other crops. During the drought it was found feasible to irrigate from wells; 23,500 acres were thus watered in 1929. Ten years later the acreage had increased to 81,000. The new flood control and irrigation dams and reservoirs will insure ample water for even more irrigation projects.

Possibly a few statistics on production of certain commodities in Nebraska may be in order:

Dairy products	2,800,000,000	lb.
Hogs	1,250,000,000	"
Cattle and calves	950,000,000	"
Sheep and lambs	45,000,000	"
Poultry	26,000,000	"
Eggs	62,000,000	doz.
Potatoes	7,775,000	bu.
Apples	500,000	"
Peaches	65,000	"
Pears	60,000	"
Grapes	3.5	tons

The above figures represent the production for a good average year, while those below are the official estimates for 1942 (as of Oct. 1):

Corn	242,984,000	bu.
Wheat	69,828,000	"
Oats	56,794,000	"
Barley	38,298,000	"
Grain sorghums	2,619,000	"
Sugar beets	1,187,000	tons
Alfalfa	1,357,000	"
Wild hay	2,347,000	"

There are a number of sugar factories in middle-western and western Nebraska. Alfalfa mills dry and grind freshly-cut alfalfa to produce a green powder which goes into cer-

tain prepared foods for animals and children.

Soy bean acreage has been gradually increasing in recent years. There are numbers of small packing plants throughout the state in addition to the huge plants of the Big Packers in Omaha. A number of canning factories handles various fruits and vegetables in season.

The plant of the American Smelting and Refining Co. at Omaha normally handles a large tonnage of nonferrous metallurgical products. In addition, throughout the state are quite a number of manufacturing plants, some very small, others of a respectable size. There are concerns which manufacture paint, cement blocks and culverts, grain bins, crossarms for wire lines, cereal products of many kinds, stock food, farm machinery, tents and awnings, candy, beer and a few other odds and ends. A few small oil refineries handle both domestic and imported crude oil.

Natural gas mains cross the state, bringing fuel at a reasonable cost. Water power plants develop around 141,000 kilowatts. There are 40–50 small plants which account for about 15,000 of the above total. This electric energy, the availability of natural gas, the new oil fields and the possibility of utilizing the small amount of low-grade coal, materially change the old fuel-power situation which was a handicap to industrial development.

When the world returns to sanity, there are some definite possibilities in the offing for Nebraska. Huge amounts of straw and cornstalks and at times large quantities of fruit culls and wind-falls could become raw materials for chemical engineering processing which should yield valuable materials. Paper, packing, insulating and building materials, alcohols and other organic chemicals, and textiles are all possibilities. Oils and starches can be produced in greater quantities from grains. Recently an excellent grade of waxy starch has been produced from one variety of sorghum grain, and much more of this grain can readily be grown. Exploration and development work might well lead to the growth of a ceramic industry. Uses may well be found for many of the mineral products now ignored. Desiccated and frozen fruits and vegetables could well be prepared in the state.

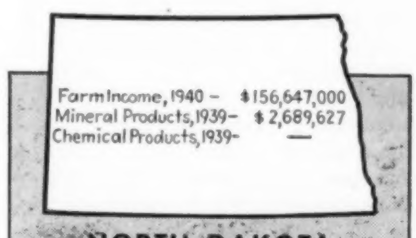
Nebraska has an excellent grade of man-power raw material. The state's population is naturally not normal at present, but there is no reason for expecting any particularly great change when normal conditions return.

The University of Nebraska, located in Lincoln, is the only school in the state equipped to turn out graduates with the B. Sc. in Engineering. The University is handicapped by lack of space and physical equipment. Two of the departments of the Engineering College have this handicap. Despite this fact, the graduates have been "delivering the goods" wherever employed. Most mid-western lads are pretty well set-up physically, are earnest, capable and loyal and are not afraid to get their hands dirty. They know that without experience they are not ready to take over and "run the show." They have self-confidence and know how to get along with people. They are trained along these lines.

In 1940-41 there were 6,823 students registered in the University with 1,332 of this number in the Engineering College. In 1941-42 the figures were 6,141 and 1,238 respectively. These figures show "campus students" and do not include others sometimes shown in registration totals. Below are shown the numbers of men graduating with the B. Sc. degree in Engineering during the last two years.

	1940–41	1941–42
Agricultural Engineering....	11	10
Chemical "	20	14
Civil "	11	10
Electrical "	18	22
Mechanical "	28	22
Totals................	88	78

The College of Engineering of the University of Nebraska expects to do its part in the future development of the state's resources. In the past the majority of Nebraska's young engineers have left the state for employment. In the future it is hoped and expected that places within the state will be available for these engineering graduates.



NORTH DAKOTA

By A. M. COOLEY

Associate Professor of Chemical Engineering, University of North Dakota, Grand Forks

THE RICHNESS OF THE SOIL in North Dakota has been exploited rather than the mineral resources which require a greater capital for their development. However, deposits of several minerals are present in enormous quantities and these are readily and cheaply accessible. Lignite, bentonite, glaubers salts and fullers earth deposits have been surveyed.

Lignite may contain from 30 to 50 percent moisture as mined and has a heating value of 7,000 Btu per pound or less. It is an efficient fuel when properly used but has a small shipping radius because of the high moisture content. The estimated reserves are about 600 billion tons; and much of it can be strip mined. It has been shown to be a source of phenols, cresols, benzene and tar, however, various factors have prevented the development of a chemical industry in North Dakota based on lignite.

From 2 to 3 gal. of tars per ton of raw lignite may be recovered during low-temperature carbonization. While the tar products are valuable the main product is char and the only use to which this could be put in large tonnages is fuel. It has a heating value of about 11,000 Btu. Future development of lignite on a large scale will depend on industries which are able to utilize it close to the mine or upon depletion of higher grade coals.

Glaubers salts is one of the mineral resources which has potential value as a means of building a chemical industry in North Dakota. The proved tonnage in the several large deposits in the northwestern corner of the State is in excess of 20 million tons. The deposits are easily workable, being dried lake beds containing glaubers salts to depths of 80 ft. Pure crystals may be harvested on the surface of the deposits at low cost. An analysis of the top bed of crystals shows that the sodium sulphate content on a moisture free basis averages about 95 percent. The principal impurities are magnesium sulphate and sodium bicarbonate.

A considerable market for glaubers salts exists in the paper industry of Minnesota and Wisconsin. This is supplied at the present time in part from Saskatchewan deposits which are the same in character as North Dakota deposits, and have approximately the same shipping distance.

An investigation at the University of North Dakota has shown the possibilities of manufacturing soda ash and ammonium sulphate from glaubers salts by a modified Solvay process. A great need exists for ammonium salts as fertilizers in North Dakota and a ready market for soda ash exists elsewhere. The combination of lignite and glaubers salts occurring together is favorable for plant location.

While the full extent of the bentonite deposits is still not known a total of 120 million tons have been surveyed. These deposits are largely without overburden. North Dakota bentonites are somewhat different from the better known Wyoming bentonites. The swelling properties are less and they contain a lower quantity of colloidal material, but the base exchange capacity is greater.

Certain other deposits of material resembling both fullers earth and bentonite have been recently discovered. The deposit has been traced from 200 miles north of the Canadian border, through eastern North Dakota and South Dakota to the Nebraska boundary. These minerals in the natural state have good bleaching properties for oils and they may be further improved by acid leaching. Canadian concerns have processed small tonnages for use in bleaching lubricating oil.

The processing of agricultural products in districts where they are grown would seem to be advantageous especially since many of the products are consumed in large part in these same localities. Large quantities of potatoes, flax seed, corn and grains are grown. A potato dehydrating plant and potato flour unit is being constructed to take care of cull potatoes which would ordinarily be used as stock feed.

North Dakota is well supplied with rail facilities. Four railway systems cross the State and branches from these give access to all sections. Cheap fuel in the form of lignite may be used for generation of power and will shortly be supplemented by the output of the Fort Peck dam which will provide power in amounts adequate for any chemical process industry that may come to the State.

By PROCTER THOMSON

Chemical Division, The Procter & Gamble Co., Ivorydale, Ohio

OHIO's material resources are almost all that could be desired. The minerals available from the soil of the state are practically all nonmetallic, but there is a wealth of them from the chemical engineer's point of view—salt, limestone, coal, clay, natural gas, (if one can call this a mineral), gypsum, abrasives, and petroleum. The Great Lakes and the Ohio River bring to Ohio at low transportation cost the few things lacking to make her economy complete—iron ore, coking coal and glass sand.

The extent of Ohio's agricultural resources may be better understood by comparing this state with the Ukraine, that territory for which Hitler was willing to set fire to the world. Ohio has approximately one-tenth of the area of the Ukraine and one-fifth of its population. The fertility of Ohio fields is at least equal to that of the Ukraine, and, under American methods of farming, can be conservatively figured to produce one-fifth as much as the Ukraine. In other words, for an agricultural equivalent of five Ohios, this war is being fought.

In Ohio is produced practically every major American crop except cotton and peanuts. The one of most industrial promise is soybeans, from which are being produced, on a near commercial scale, such diverse industrial products as synthetic wool and synthetic rubber. I predict that there is more than a fair chance that *Chem. & Met.* readers will ride on soybean rubber (Norepol) recaps before the war is over.

Ohio's central position has led to the establishment within her borders of numerous chemical industries not directly connected with the state's own resouces. For example, rubber, soap, paint and varnish, heavy chemicals, and plastics are materials in which Ohio's production is a substantial fraction of the national output.

All of the resources and industrial capacity outlined above are at present contributing heavily to the war effort. In addition to these, the government's contracts for airplanes, machine tools, etc., bring Ohio's war effort to third place among the states, being exceeded only by that of Michigan and New York. As of July 1, 1942, Ohio led all the states in awards for defense plant construction with a total exceeding $1.1 billions.

What does all of this mean for the future—the post-war development? What it will mean will depend upon the manpower, the technical skill and resourcefulness with which all of these magnificent resources can be marshalled to meet the tremendous problems of the post-war period. The amount of more mature technical brains in the state can be estimated by the fact that 7.25 percent of the membership of the American Institute of Chemical Engineers is located in Ohio, and that 11.75 percent of the membership of the American Society of Mechanical Engineers is also in Ohio. For new technical knowledge the engineering schools of Toledo, Akron, Case, Ohio State, and Cincinnati, as well as her many other educational institutions, can be looked to with confidence.

With all of these resources of men and material, what will we do after the war? In the way of new developments, some things already stand out rather clearly.

From plastics there will probably not be auto bodies—steel or aluminum are too handy for that—but windows made entirely of plastic for cars are clearly indicated. For homes, inside storm sashes light in weight will fill a long-felt want. There will also be plastic pipes for chemical solutions, leather-like "fabrics" for furniture, containers for food and lamp standards and reflectors, particularly for homes.

In synthetic rubber, Ohio is out in front. Assuming for the moment that natural rubber may come back in the picture, synthetic rubber will still have a place in many types of special service. Where oil and gasproofness are required, or odorless gaskets for food containers, or nonflammable insulation for wires—to mention just a few cases—the synthetic rubbers will have an advantage.

From glass we will have insulation against heat and cold, handier and quicker to install than present types; we will have double-glazed windows at prices no greater than the present

single windows, and glass blocks superior to any now on the market.

Powder metallurgy will extend along lines now in production to give us special self-oiling bearings, cutting tools containing tungsten and similar carbides, and gears made directly from metal powder and requiring little finishing.

In the field of aeronautics, helicopters and autogyros will supplement private airplanes of conventional type to make the personal air car as common as the personal road car was in, say, 1915.

Automobiles, lighter in weight, and powered with motors designed to run on 100-octane gas, will not only be feasible but probable. If tools and dies for present day cars are scrapped in the salvage drive, new car design will start without any inhibitions at all.

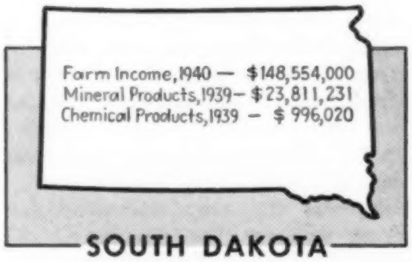
Furniture will, no doubt, be virtually revolutionized. Aluminum and magnesium will furnish material that will be as light as wood without the glue-joint problem in winter. Magnesium has already been developed in alloys of non-flammable character so we need not worry about sitting on the "hot seat" of an incendiary chair.

Synthetic resins will permit manufacture of "bent wood" furniture similar to that shown in the Swedish Pavillion at the World's Fair in New York. Urea-impregnated plywood may also invade this field.

Synthetic detergents, now playing an important part, will expand but in this writer's opinion will probably be limited to special fields.

In foodstuffs, wheat flours fortified with soybean and peanut proteins will be the standard. No longer will good edible proteins be fed to animals to reconvert inefficiently. Solvent extraction may do the same with vegetable fats. There is no reason to feed fat to an animal just so it can manufacture fat.

But these technical developments will not be enough. The engineer will have to become as important in state building as the lawyer is now. Somehow he will have to become the man who is looked to for the answer to the question. "What will we do next?" in hard times as in good. Will we put men to raking leaves on Indian mounds and helping inefficiently to build stadia for one-horse high schools? It is definitely up to the engineering profession to put across to the people and the politicians that there is real work to be done, work that must be done in our generation, come post-war boom or depression. For instance, the Ohio River must be freed from pollution. This means building sanitary sewage disposal plants for all of the communities along the Ohio. This activity alone will absorb many of the jobless back from the war, and, equally important, make work for cement mills and tile factories. In each area of Ohio the engineer must make his influence felt to get the local resources used in making contributions to the real wealth of the state, contributions of genuine economic value. Then Ohio will live up to her motto, "Imperium en Imperio"—An Empire Within an Empire.



By A. D. CAMP
Manager Technical Data Department, Dorr Co., New York, N. Y.

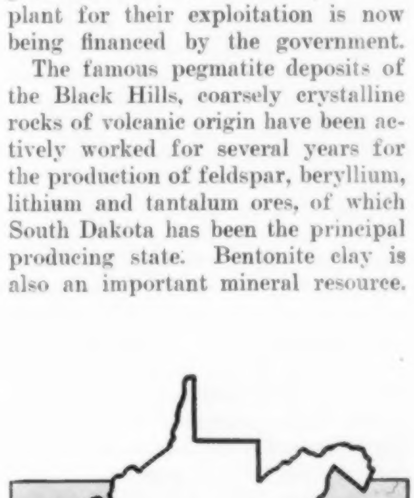
South Dakota is known principally as an agricultural and cattle raising state and most of its farming products are shipped outside of the state for further processing. It is a very large producer of corn, wheat, oats, barley and flax seed, but the industrial exploitation of these raw materials has shown very little progress within the state.

South Dakota has a small crop of sugar beets which is converted in the plant of the Utah-Idaho Sugar Co. located at Belle Fourche. Its capacity is about 1,550 tons of beets per day, producing about 30,000,000 lb. of sugar per year. The best known processing industries of South Dakota are those which operate on its quite plentiful mineral resources which are concentrated largely in the Black Hills district consisting of Custer, Lawrence and Pennington Counties. It is among the leaders in the mining of gold and tin and of several of the minor minerals such as ores of lithium, beryllium, tantalum, manganese, feldspar and bentonite.

South Dakota stands second among the states in the production of gold, largely because of the existence at Lead and Deadwood of the Homestake Mining Co., which for years, has been the largest gold producing mine in the United States. It employs the cyanide process of gold extraction. The invention of the Dorr Classifier in a gold mine at Terry, S. D., in 1904, has had a beneficial influence on the concentration of metallic and non-metallic minerals throughout the world.

The state has the distinction of possessing at Tinton the only tin producing mine in the United States, but its output can supply considerably less than one percent of the metal needed by the nation. There are huge deposits of low grade manganese ore at Chamberlain, and a plant for their exploitation is now being financed by the government.

The famous pegmatite deposits of the Black Hills, coarsely crystalline rocks of volcanic origin have been actively worked for several years for the production of feldspar, beryllium, lithium and tantalum ores, of which South Dakota has been the principal producing state. Bentonite clay is also an important mineral resource.



By WILLARD W. HODGE
Department of Chemical Engineering West Virginia University, Morgantown, W. Va.

During the past twenty years West Virginia has developed rapidly as an industrial state and in the application of modern scientific methods to agriculture. The area of the state is 24,181 sq.mi. The population in 1940 was 1,901,974, a 10 percent increase since the 1930 census. The growth of industries has been based largely on the abundant natural resources of bituminous coal, natural gas, limestone, sand, clay, and considerable amounts of petroleum, salt, and timber. There are large deposits of iron ores, and some manganese

ores, but their renewed utilization awaits the results of scientific and engineering research to process low grade ores economically. The most outstanding manufacturing developments in recent years have been along the lines of metallurgical, ceramic, synthetic textile and chemical products; and plant construction is now and probably will continue active in these fields of industry.

COAL RESOURCES

Coal Resources and Mining. The coal column of the state, as compiled by the West Virginia Geological Survey shows 117 seams of bituminous coal; 60 minable and 57 considered unimportant at present. In 1863 there were 444,648 tons of coal mined in West Virginia. Production gradually increased to a peak output of 146,008,000 tons in 1927. In 1928 and each year since 1931 this State has held first place in the quantity of bituminous coal mined. Annual tonnages during the decade 1930 to 1940 have ranged from about 86,100,000 in 1932 to 126,600,000 in 1940. Yearly values have varied from approximately $93,000,000 in 1932 to $223,518,000 in 1940. Geologists' estimates placed the State's original coal resources at 116,705,000,000 tons. Including 1940, coal mined has totaled about 3,740,000,000 tons. Hence, the coal reserves amount to 112,965,000,000 tons, sufficient to serve industries for 200 years or longer.

There are wide differences in the chemical composition and physical properties of coal from different beds. Volatile matter ranges from 16 to 20 percent in Pocahontas coal; from 30 to 36 percent in No. 2 Gas and Pittsburgh seam coals. A number of the coal beds are low in ash and sulphur and have strong caking properties so are in demand for the manufacture of metallurgical coke. Formerly most of the coal mined in West Virginia was shipped out of the state, but now larger proportions are used locally for power generation, heating purposes, byproduct coke production, and as a raw material for certain rapidly growing chemical industries. Since 1932 many of the coal mines have been mechanized and other improvements installed. There are many opportunities for further scientific and engineering researches for improvements in mining methods, preparation of coal for different markets, and more efficient utilization of bituminous coal, West Virginia's greatest natural resources.

Petroleum, Natural Gas, and Natural Gasoline stand next to coal among the state's industrial raw materials. The output of petroleum is less than in 1901 when the production was 14,177,000 bbl. However, the excellent quality of the crude oil obtained has induced continued drilling for new wells and pumping of many of the older wells. Improved scientific methods of prospecting have enabled the geologists to locate with greater precision the underground resources of petroleum and gas and new wells are brought in every year. In 1940 the 18,000 active oil wells produced 3,426,306 bbl. of petroleum, valued at $6,000,000. Total production of oil in West Virginia from 1863 to 1940 is given as 413,865,016 with an average value of approximately $2 per bbl. There are now three petroleum refineries in the State. In 1939 they produced $10,549,149 worth of products.

The production of natural gas in the state has increased from 111,000,000,000 cu.ft. in 1935 to 160,000,000,000 cu.ft. in 1940, from 13,860 gas wells. In this year the state issued 508 permits to abandon and 774 permits to drill new oil and gas wells. Gas wells completed numbered 508 and oil wells 94. The high B.t.u. value and cleanness of the natural gas produced makes it a preferred fuel in many industries. The products obtained by cracking processes applied to the oil and gas and by fractional distillation of the natural gasoline are the desired raw materials for large and rapidly expanding chemical industries whose initial plants, industrial development, and economic success are the result of scientific and engineering education and research activities.

Limestone, sand and workable clays are abundant in certain sections of West Virginia and adjacent states. These resources plus cheap natural gas early attracted the ceramic industries. However, as the gas became higher in price it has been the resourcefulness of the men in these industries which has kept them operating and growing in production and economic importance. The country's largest glass bottle factory and sheet drawn glass plant are located in this state. The ceramic industries in the state are represented by the classification and number of companies; cement and concrete products 30; cement mills 3; brick, tile, and clay products 23; china, porcelain and pottery 23; sand, gravel and road material 38, glass and glassware 64. The annual value of products of the ceramic industries in 1939 amounted to more than $80,000,000.

Metallurgical Industries, especially iron and steel were among the early manufactures in West Virginia. The Henry Clay furnace located near Morgantown when started in operation about a century ago was said to be the largest iron furnace west of the Allegheny Mountains. Its capacity was four tons of iron per day. The discovery of the rich hematite ores in Minnesota and Michigan soon put an end to the ferrous industry in the central part of the state. However in the Northern Panhandle, at Wheeling and Wierton two of the nation's leading steel companies have extensive operations; furnaces, mills, and fabricating works. There are many other iron and steel products plants in the state, also the very large U. S. Naval Ordnance works near Charleston.

The non-ferrous industries are represented by two zinc smelters, the largest Monel metal and nickel plant in the United States is located in Huntington, and large electro-metallurgical, ferrochrome and ferrosilicon works are at Glen Ferris and Alloy. There are plants for rolling, casting or stamping aluminum, brass, bronze and other alloys. The total number of companies making metallurgical products is 81 and the total value of products in 1939 was more than $160,000,000; second only to the value of coal mined in the state that year.

PROCESS INDUSTRIES

Chemical Engineering Industries have made phenomenal developments in West Virginia during the past fifteen years. Here truly, natural resources and human resourcefulness have been efficiently combined to make from crude materials, some of them formerly wasted, products of great value to humanity in attaining the better and fuller life. Probably the first chemical industry in the now highly industrialized Kanawha Valley, was the preparation of salt from brines. The Dickinson and Shrewsbury salt furnace started in 1832 and is still in operation. The plant has been enlarged and recovery processes for bromine and other useful byproducts installed. This is one of the three surviving salt companies in the state. However, as the result of research applied to salt, there are within a few miles of the salt works, two large electrolytic chlorine and caustic soda plants one of which is the largest in this country.

One of the world's largest synthetic organic chemicals plants is in

South Charleston. This plant and one built in Whiting, Ind. a few years ago, and another recently completed in Texas, are industrial developments resulting largely from research fellowship work started at Mellon Institute in Pittsburgh about 20 years ago, followed by pilot plant investigations at Clendenin, W. Va. On a nearby plant site one of the Government's large, butadiene plus styrene, synthetic rubber plants is now under construction in cooperation with this company's chemical and engineering staff.

It was fortunate for our country that in the present war crisis, through foresight and resourcefulness, another progressive chemical company had in operation a large synthetic ammonia works at Belle (near Charleston) W. Va. Otherwise our supply of nitric acid for the manufacture of explosives would have been seriously limited. It takes years of research and development to solve the process and equipment problems, properly train the chemical, engineering and operating men safely to apply pressures on gases up to 10,000 to 12,000 lb. per sq. in. in producing liquid ammonia from the principal raw materials, coal, air, and water. Additional products manufactured in the plant are methanol, ethanol and other alcohols; urea, useful as a fertilizer and for making plastics; formates; and nylon intermediates. During the past two years this company's engineers and chemists have cooperated with the government in the construction and operation of another synthetic ammonia plant near Morgantown, W. Va.

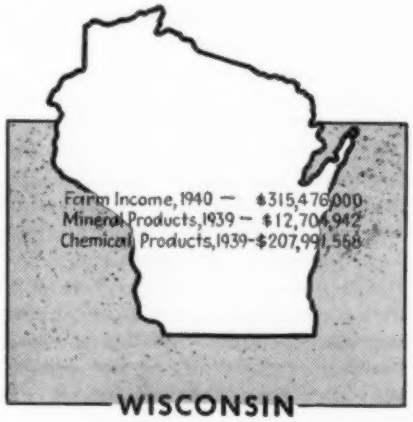
The present intensive interest in rubber, rubber reclaiming and rubber substitutes has called attention to the research and production operations of a large synthetic organic chemical industry in Nitro, W. Va. This company has for many years specialized in the development and manufacture of chemicals of service to the rubber industry. The plant has been a pioneer in this field; also for other special purpose organic compounds. It has expanded rapidly and is still growing.

There are in West Virginia many other chemical plants and process industries including among their products the following: barium compounds, ultramarine, lead oxides, pharmaceutical preparations, sulphuric acid, carbon electrodes and plates, food products, paints and pigments, leather and textiles, coke and byproducts.

The older textile operations are mostly woolen mills. Sheep raising is one of the more important agricultural pursuits in the State. The newer textile industries are based on chemical and engineering research producing from wood pulp and cotton linters the beautiful viscose rayon in large, comparatively recently built plants in Parkersburg and Nitro. In 1939 the value of leather and textile products was about $19,500,000. The growth of the chemical manufacturing industries is shown by the annual value of products being only $2,995,000 in 1932 and $82,423,000 in 1939.

In addition to great reserves in natural resources, of raw materials for chemical, metallurgical, ceramic and other process industries, West Virginia possesses an important supply of native born, intelligent workers. The State has a good public school system. There are fourteen denominational and private colleges and schools and ten state-supported colleges. The West Virginia University heads the state educational institutions. It comprises colleges of: Arts and Science; Law; Engineering; Agriculture; Forestry and Home Economics; Education; and Pharmacy. There are also schools of Journalism; Music; Physical Education and Athletics; and Medicine. In addition to their instructional duties, many of the departments carry on research and investigations. Organized primarily for research are the Agricultural Experiment Station and the Engineering Experiment Station. Also located at the University and devoted to research is the State Geological and Economic Survey. Each of these agencies publishes a series of bulletins summarizing their investigations.

Within the past 15 years there have been constructed at the University the largest hall of chemistry south of the Mason and Dixon line, an $800,000 library, the engineering building has been enlarged and remodeled, and a new well equipped $1,000,000 mineral industries building was dedicated last October 16. Apparently the reserves in West Virginia of many important industrial raw materials are abundant and good opportunities for developing human resourcefulness are freely available to the people, and are being increasingly applied to scientific and more efficient utilization of the state's natural resources.



WISCONSIN

By O. A. HOUGEN
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Wisconsin is known as the "Dairyland of America," but it is not generally known that Wisconsin is more of an industrial than an agricultural state and ranks eleventh in this respect among the United States. Of Wisconsin's total workers, 32.5 percent are employed in manufacture as against 24 percent in agriculture. In 1935 the value of the state's agricultural products was $470,890,000 as against $546,043,000 for the value added by manufacture. The 1940 census gives for 1939 a population of 3,137,587, manufacturing establishments, 6,717, employing 233,691 people, a value of manufactured goods of $1,604,507,356 and a value of products added by manufacture of $686,605,326. Over 90 percent of the products manufactured are sold outside of the state.

The leading industries of Wisconsin today are engaged in the manufacture of agricultural implements, motor vehicles and parts, paper and pulp, foundry and machine shop products, electrical machinery, knit goods, boots and shoes, evaporated milk and canned goods, listed in decreasing order. In comparison with other states, Wisconsin in 1935 ranked first in the production of butter, cheese and evaporated milk, second in paper and pulp, agricultural implements, tractors, engines, aluminum products, plumbing supplies, cranes and hoists; third in beer and malt, mattresses and springs; fourth in tanned leather; fifth in motor vehicle parts, knit goods, wooden boxes, and steel and iron forgings.

The industries of Wisconsin are

linked with its agricultural products in the manufacture of beer and malt, butter, cheese and evaporated milk, canned goods, meat packing, tóbacco products and beet sugar refining. Textiles, hides, wool and hair are produced in insufficient amounts to supply the industries of the state. Most of the forest products which are used in Wisconsin industries as in planning mills, and paper and pulp industries, come from outside of the state, chiefly from Canada, although the lumber for boxes and furniture still comes partly from the remaining forests of the state. The mineral-linked industries of Wisconsin derive their raw materials chiefly from outside of the state. This is true of coal, oil, asphalt, all metals, and cement. At one time mining of zinc and lead ores was the leading industry of Wisconsin. In 1935 only 2 percent of the nation's zinc ores was mined here. An inferior grade of iron ore, to the extent of 2,000,000 tons annually, is mined in the Gogebic Range. The state has extensive deposits of clay and dolomitic limestone, and large quarries of marble, granite, slate, and building stone, but most of the minerals and all the metals used in the production of chemicals, explosives, paints, aluminum ware, and heavy machinery come from other states.

DISTRIBUTION OF INDUSTRIES

The distribution of Wisconsin industries arranged as to source of raw materials is tabulated as follows:

Raw Materials	Employment %	Wages %	Value added in manufacture %
Iron and steel	35.4	41.6	35.8
Agricultural .	32.6	29.4	32.8
Forest	20.8	18.8	18.2
Non-ferrous metals	6.2	5.7	8.1
Miscellaneous.	5.0	4.5	5.6

Commercially Wisconsin is associated with the Great Lake states in its competitive manufacturing activities. In this group, with the exception of Illinois, Wisconsin enjoys the greatest diversification of industrial activities, with less than 10 percent of its workers in its largest industry. Furthermore, Wisconsin has an even balance of manufacture in consumer and capital goods. These advantages are favorable to steady employment and steady production.

Throughout its history astonishing changes have taken place in the industrial activities of the state, bespeaking highly for the intelligence of its people, its many skills and diverse interests. In its earliest history, fur trading was the sole industry of the territory, an enterprise which today has been restored in great fur farms. The first leading industry of the state was in the mining of zinc and lead ores, an industry which has declined to a position of minor importance. In the 1890's Wisconsin led in the cutting of timber but today most lumber and logs are imported. In the 1900's, flour milling was a leading industry. These mills have moved West and the old sites have been taken by paper mills; Wisconsin is no longer a wheat growing state. Brick and tile production were at peak load in 1904 and has been largely replaced by concrete. Leather production has lost its high rank by importation of hides from South America to the tanneries of the east. Malt and beer have not regained the same relative national importance as before prohibition. Tobacco manufactured products have declined with the growing popularity of cigarettes which are manufactured elsewhere. Wooden box and furniture manufacture have shrunk with the lumber industry. Through unusual skill and good management the paper and pulp industries continue to thrive and flourish despite the loss of local forests.

The heavy metal products industries of Wisconsin originated with the early demands for machinery in logging camps, sawmills and planing mills. These industries have been transformed and extended into the production of tractors, automobiles, engines, cranes, hoists, generators, motors and pumps.

Industrially Wisconsin holds a favorable position because of its ready access to the Great Lakes, nearness to the industrial markets of Chicago and the agricultural markets of the west, availability of iron and steel through lake ports, good power and transportation facilities, and an abundent supply of highly skilled and intelligent labor. Improvement of direct foreign shipping facilities on the Great Lakes would be of further great benefit to the state.

Many opportunities for future development seem favorable and imminent, depending largely upon chemical and engineering skills. A better grade of lime should be developed from the magnesian limestone deposits of the state to increase local production of cement and for use in metallurgy, paper mills, tanneries and water purification. A stimulated research program on Wisconsin clays is under way to revive the production of brick and tile. The quartzite deposits of Rib Mountain and Baraboo are being used in the production of roofing grits and ganister. State Geologist, E. F. Bean, reports that mineral resources awaiting development are nepheline syenite, feldspar and quartz for glass manufacture, zircon, talc, kyanite and shale. The state is in need of factories for making soap, glass, rubber, plastics, and rayons. The greatest industrial opportunities of the state seem to be in the development of organic industries through its rich agricultural linked raw materials. The famed biochemical development of the state is a source of superior skill in the establishment of fermentation industries for the production of new organic chemicals from agricultural products. Recently developed methods of quick freezing and desiccation of foods offer new possibilities to the food industries of the state.

The climate of Wisconsin is invigorating and stimulating to creative enterprise. Abundant and distributed precipitation insure dependable and diversified crops.

MANPOWER

The people of Wisconsin are a sturdy, intelligent group, with diverse skills and unusual resourcefulness. Attesting to the versatility of its people, during the period from 1914 to 1935, 48,167 jobs were lost in Wisconsin, chiefly in the wood working industries, whereas 104,130 new jobs were created, chiefly in the heavy machinery industries. The majority of technical graduates of Wisconsin colleges remain in their home area after graduation. For example, 55 percent of the graduates in chemical engineering of the University of Wisconsin find employment in Wisconsin and the Chicago area. The number of graduate chemists and chemical engineers leaving the state is more than offset by those entering from elsewhere. The spirit of research is prevalent in the institutions of Wisconsin. Graduate studies and research have been stimulated at the University to a large scale through the activities of the Wisconsin Alumni Research Foundation. The University of Wisconsin, the Federal Forest Products Laboratories at Madison, and the Paper Institute at Appleton all carry on extensive research programs in widely diversified fields. The prevalent spirit of cooperative research linking all branches of science, coupled with the enterprising spirit of Wisconsin industries insures the necessary technical skill and business acumen to establish new industries in the state and to surpass its past performance.

Pioneering the Middle West—Today and Tomorrow

CHESTER C. DAVIS, *President, Federal Reserve Bank of St. Louis, St. Louis, Mo.*

***Chem. & Met.* INTERPRETATION**

No one in the United States is better qualified than Mr. Davis to give us this over-all picture of what the future holds for the Middle West. Two years ago, as agricultural commissioner of the old National Defense Advisory Commission, he himself pioneered in the fight to locate new war plants in areas remote from the existing concentrations of heavy industries. His success in that effort established a basic principle that has since guided practically all of the subsequent programs of the war agencies. Now Mr. Davis is looking bravely ahead to the day when these plants will have served their immediate purpose. In this article he portrays the new challenge which "men of courage and vision in chemical engineering" must face in adapting these facilities to the job of serving a new world in which the Middle West is destined to play a leading role.—*Editors.*

Born on a farm in Dallas County, Iowa, Nov. 17, 1877, Chester Charles Davis is a true and native son of the Middle West. After graduating from Grinnell College in 1911, he served as a newspaper reporter, then as editor and manager of a farm journal. This directed his interest to agriculture and eventually to the then unchristened field now known as "chemurgy." He was executive vice president of National Cornstalk Processes, Inc. and of Maizewood Products Corporation before being called to Washington in 1933 to direct the production division of the Agricultural Adjustment Administration, which he was later to serve as national administrator. In June 1936 he was appointed a member of the board of governors of the Federal Reserve System, and in April, 1941, resigned to become the president of the Federal Reserve Bank of St. Louis. His close connection with the national defense and war efforts began in 1934 with his appointment to the National Emergency Council, and carried over into the National Defense Advisory Commission in which he represented the interests of agriculture.

PIONEERING is a strong tradition in that vast inland empire between the Rockies and the Alleghenies. It has been only a tick of history's clock since its waterways knew Joliet and LaSalle, Lewis and Clark, and its trails knew Daniel Boone.

Many of us look back longingly on those pioneer days when we had geographic frontiers to conquer. We long for their return. Yet the frontiers that surround us today are so vast and breath-taking in their challenge as to make those brought under control by our pioneer forefathers seem simple and easy in comparison. The old frontiers called for the explorer and his boat, the woodsman with his axe, and the plainsman with his covered wagon and his plow. The new frontiers challenge the chemical, electrical, mechanical, and industrial engineers, and the men of social and economic vision.

Pioneering today and tomorrow will reward success and penalize failure as it did yesterday. But the stakes have grown in size and importance. The expanding future of our kind of life on this continent depends on success; the penalty for failure will be too serious to contemplate.

I am thinking that the great need of our generation is to use the full capacity of our human and natural resources. The more productive we become, the more certain we are to win the war, and the sooner we can win it. After the war, we face the challenge to supply an economic order based on relatively full and continuous employment, and a high and rising standard of living.

Recently business leaders from every part of the United States took steps to incorporate and finance a cooperative planning effort aimed to "foster the full contribution by industry and commerce in the post-war period to the attainment of high and secure standards of living for people in all walks of life through maximum employment and high productivity in the domestic economy." That full task lies ahead of us.

No matter how long it takes or what the costs may be, our first job is to win the war. When it ends, we should find ourselves in possession of the best equipped, most extensive and diversified mechanical plant in the world's history, manned by the greatest army of trained factory workers ever known. These, with our great natural resources, are the elements of real wealth. Our job is going to be to learn how to use them and use them well. Men of courage and vision in chemical engineering face a real challenge then, just as they have faced one in the past year with the world at war.

It is hard to generalize about a region so vast and diverse as that contained in the fourteen North Central, Midwestern, and Great Plains

States. As a whole, these states are the arsenal as well as the bread-basket and meat storehouse of the nation. Since June 1, 1940, 37 per cent of the war supply and facility contracts, exclusive of food, have gone into this area. By states, however, a glance at the distribution of war contracts reveals extreme diversity. Whereas Michigan, the home of automotive industry, leads the nation with over 10 per cent of the national total, North Dakota has received practically no direct war business. South Dakota reports but slightly more. I am not quarreling over this, but merely stating the fact to illustrate the impossibility of a generalization that applies equally to all parts of this great empire.

Nevertheless, I believe the great raw materials regions need to be more highly industrialized if this nation is to reach and hold its maximum production and employment. That is only one of the reasons why, as a member of the National Defense Advisory Commission, I fought as hard as I could to get new war plants placed in the interior United States outside of regions of previous industrial concentration. Recently a great deal has been done under that principle.

It is a commonplace of economic history that the growth and development of a country is profoundly influenced by war and industrial expansion for war purposes. The industrial history of the United States is itself an excellent example. During the Civil War the industrial facilities of the northern states were expanded rapidly. The North had a nucleus for this expansion which the South did not have. This expansion gave the North and the Northeast a head start in industrialization which it has maintained until the present time.

World War I brought a new period of expansion in which we located our new war industries close to the old centers of industrial activity. The result reinforced the industrial concentration of the northern and northeastern states.

Yet in a country such as the United States it is inevitable that industries which were once well located should, in the course of years, find themselves not so well located. From colonial days to the present time, the center of population of the country has steadily shifted westward; sources of raw materials change; means of transportation and market locations change. Particularly are these changes to be noted in a country as large as the United States, with such diversity in climate, in soils, and in natural resources.

The relocation of industries to meet shifting conditions lags, and as a result there is a more or less chronic dislocation of industries. Only with great reluctance, and decades after the move was logical, did the owners of the New England cotton spinning and cotton finishing mills begin the relocation of their industry. So with many another industry. Once established in a given location, there are dozens of reasons, some of them valid, for an industry to "stay put" long after the conditions have vanished which made the original location a logical one.

One result of the war, so far as industry location is concerned, has been to shift industry inland. Naturally, if magnesium is to be made from sea water, the plant must be on the coast, but in general the new munition plants have been built far inland. The whole region from the Alleghenies to the Rockies is now dotted with plants unrelated to the old pattern of industry location. Industrially the central part of the country has greatly increased in importance relative to the coastal area. For decades the population center of the country has moved inland; agriculture has moved inland; without intentional offense to Harvard, Yale, and Princeton, one might even suggest that the center of culture has moved inland. Massachusetts may be surprised to learn that ships are now built in Missouri; Connecticut's small arms plants are small indeed when measured against the similar plants located west of the Mississippi.

As a result of our current war effort, plants of many sorts, most of them built with Federal funds, are now scattered over the country in locations where heretofore there has been no manufacturing. Undoubtedly some of these plants will not be kept in operation after they have served their present purpose in production of war gear. On the other hand, many of them can and should survive, and will survive if a sufficient number of people take sufficient interest in them.

It is perfectly clear that the continued use of these plants will not, in some cases, be favored by the already established industries. The battle which was waged over the Muscle Shoals nitrate plant from 1919 to 1933, and for some years thereafter, is probably a fair sample of what may be the attitude of industry toward the Government-owned plants once the war is over. One of the tasks ahead will be to work out a sound policy with due regard to the interests, both private and public, as they appear.

Most of us will agree that it is not in the public interest to displace private enterprise. It would, of course, be a happy outcome if industry should find that it is to its interest as well as in the public interest to operate plants in many places remote from its old locations. The public's interest in these plants is not limited merely to making sure that, by one means or another, the taxpayers whose money built the plants get the greatest return possible from their investments. There is the greater question to be answered, whether the conversion and continued use of the facility will contribute substantially to employment and the standard of living of the people. Enlightened self-interest should insure that chemical engineers lead the way in seeking constructive answers to that question.

There is no difficulty these days in getting agreement in any group on the thesis that the world in which we shall find ourselves after this war will be different in many ways, economically, socially, spiritually, from the pre-war world. World War I gave us a synthetic ammonia industry. The present World War will give us a synthetic rubber industry, a greatly expanded light metals industry, an enormously greater production capacity for many things useful alike in peace and war. Among others, we will have air-transportation of freight, newly developed natural resources, and more hydroelectric power.

In the new world, which will be ours after the war, it may well turn out that plants which would have appeared quite out of place a few years ago will then fit surprisingly well into the new industrial pattern. In fact, if only those parts of that post-war world which are already clearly emerging be considered, there is every reason to believe that many of the present war industries will survive. The new magnesium-producing plants are not all doomed to failure. The new aluminum production capacity will certainly be needed indefinitely. Synthetic rubber is here to stay. The great airports will surely be a part of the new pattern.

Pioneers of today and tomorrow must think in new patterns, and act boldly, if yesterday's problems, which we laid aside to enter the war, are not to overwhelm us when the guns over the world fall silent.

A recent view of the new Northern Regional Research Laboratory of the U. S. Dept. of Agriculture

Where Midwest Agriculture and Industry Meet

H. T. HERRICK

Director, Northern Regional Research Laboratory[1]
Peoria, Illinois

Chem. & Met. INTERPRETATION

Ranking high among the scientific and engineering agencies serving the industries of the Middle West is the Northern Regional Research Laboratory of the U. S. Department of Agriculture at Peoria. It was authorized by Congress in 1938 for conducting research to develop new industrial outlets for agricultural surpluses. Now that every facility we have is vitally needed in the war effort, its program has been shifted to a series of outstanding projects to contribute strategic raw materials for synthetic rubber, new motor fuels and starches, cork substitutes and vital medicinals. In this article its able director, who had much to do with the original planning, equipping and staffing of all four of the regional laboratories, goes beyond the usual accounting of the bricks and mortar, laboratory apparatus and mechanical equipment to tell the real story of the basic thinking that underlies the program at Peoria. It holds much of interest and importance to all *Chem. & Met.* readers.—*Editor.*

From the beginning, the main objectives of research in agriculture have been the increasing of production per acre and the decreasing of the manual labor required to attain this production. The efforts of the U. S. Department of Agriculture and the State Agricultural Experiment Stations in this country have been so successful that for some time it has been evident that the ability to produce has outstripped the ability to use farm commodities in the age-old outlets for food, shelter, and clothing. In part as a result of this success, and in part because of waning consumption in large fields of former agricultural use, the United States, in normal times, at least, has found itself with a surplus of agricultural commodities over normal consumption, and with distress rather than prosperity among agricultural producers.

(*Continued on following page*)

[1] The Northern Regional Research Laboratory is one of four regional laboratories authorized by Congress in the Agricultural Adjustment Act of 1938 for the purpose of conducting research to develop new uses and outlets for agricultural commodities. These laboratories are administered by the Bureau of Agricultural Chemistry and Engineering, Agricultural Research Administration, U. S. D. A.

The situation that this country faced in the thirties could be met by either a limitation of surplus production, as in the case of overproduction in industry; or by the discovery of new markets to utilize over-extended production facilities, also as in industry; or by any necessary combination of both. The developments of chemistry in non-agricultural fields long ago pointed the way to new uses of the carbohydrates, the proteins, the fats, and the fibers, as well as other components of agricultural products, as raw materials for the wider outlets of industry. The idea of applying technology to the opening of new industrial markets for agriculture aroused widespread interest and this possibility of contributing to the solution of the woes of agriculture brought agricultural producers and consumers together in a movement which bore fruit in congressional action.

On October 22, 1939, the then Secretary of Agriculture and now Vice President Henry A. Wallace laid the cornerstone at Peoria, Illinois, for a new type of laboratory—a laboratory to work exclusively on finding a place for agricultural raw materials in new fields of industrial utilization. This laboratory was one of four such institutions set up by Congress in the Agricultural Adjustment Act of 1938, all of which were to be devoted to the same basic purpose, but each confined to commodities of the area in which the laboratories were located and from which they were named—North, South, East, and West. The commodities selected for the laboratory serving the North Central States—the Middle West—are corn, wheat, soybeans, and agricultural residues.

For purposes of the record, it is well to note that ground for this laboratory was broken in June 1939. The laboratory was entered and research started in December 1940. Including building and equipment, it cost about $2 million, it receives an annual appropriation of $1 million, and when fully staffed will employ about 200 scientific workers drawn from industry, the universities, and elsewhere in the Government service. In addition there is an auxiliary force of about 100 clerks, mechanics, and guards. Because of the times, and the call of industry for technical men, the laboratory force is far from static and has not yet reached its maximum development.

In planning the laboratory building, a design was adopted consisting of a U-shaped structure of three stories and basement. Offices, library, and conference rooms occupy approximately the 210-ft. base of the U which forms the building. One of the wings, which is approximately 260 ft. long, is devoted entirely to laboratories. The other includes a few laboratories, but is intended primarily to house pilot plant operations.

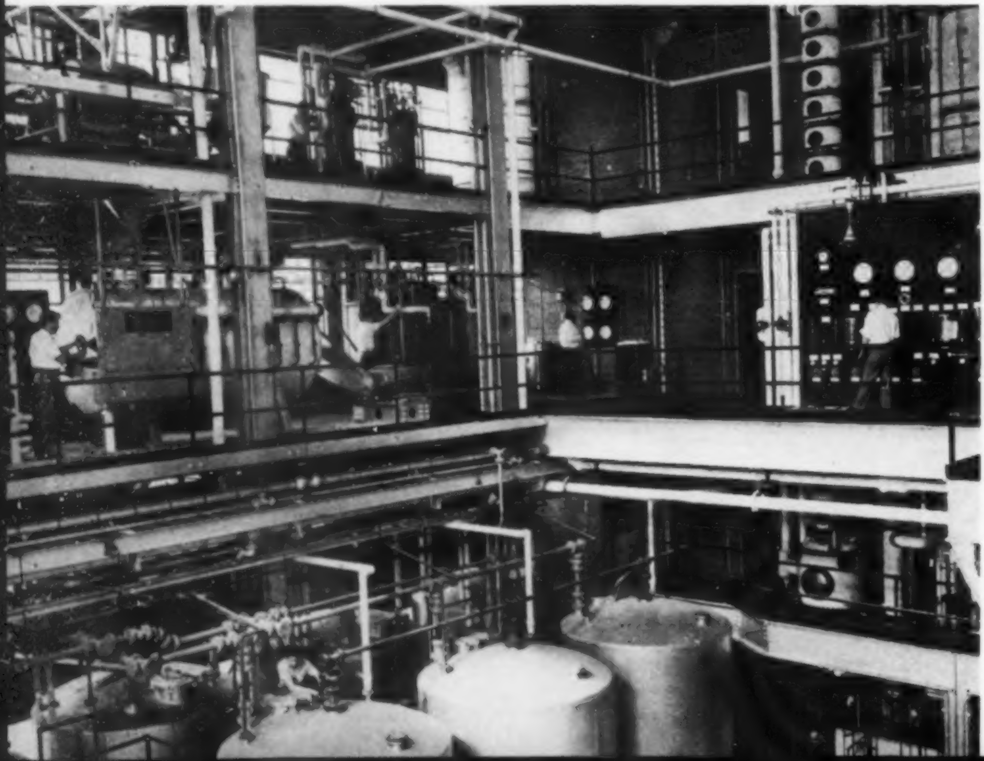
The story of this laboratory, its facilities and its future, is only to a minor extent the accounting of the bricks and mortar, the steel and copper, and the mechanical equipment entering into its construction, for the success of any research organization depends on the basic thinking underlying the program adopted, and the steps which have been taken to make thought blossom into realization. It can, therefore, be safely assumed that the Northern Laboratory has modern equipment, and will continue to acquire the apparatus which is necessary to translate thinking into accomplishment.

The program of the laboratory is, of course, based on the commodities assigned to it. These were originally corn, wheat, and agricultural residues. Very recently the U. S. Regional Soybean Industrial Products Laboratory has been transferred to the Northern Laboratory and integrated with it. Fortunately, the program of the soybean laboratory has been of such a nature as to permit its absorption in the program of the Northern Laboratory with very little modification.

Before describing the detailed planning for research, there is one point which should be strongly emphasized and which must be remembered in all points of the discussion. This is an industrial laboratory. If it does not produce concrete results in the form of uses of agricultural products acceptable to industry, it has failed, regardless of any fundamental contributions to scientific knowledge. With this in mind, the workers in the laboratory are thoroughly imbued with the idea that accomplishment in the fields of industrial endeavor is to be expected from them, and that such accomplishment can be based only on the industrial as opposed to the academic attitude. It must not be thought, however, that fundamental research plays no part in the planning of the laboratory program. In all modern industrial research, fundamental considerations should be given their place, since the fundamental chemistry of today is the practical application of tomorrow. No better example of this could be mentioned than the paper by Carothers on the fundamental chemistry of polymerization, which preceded by ten years the accomplishment of nylon.

Consider for a minute the group of commodities assigned to this laboratory. These could be described one by one in their relation to the research program of the laboratory and, in a broad way, in their relation to the research program of the other laboratories, but such a description might very well be repetitious and wearisome. Furthermore, while a certain amount of attention is devoted to the studies of the commodities as such, a larger part of the work

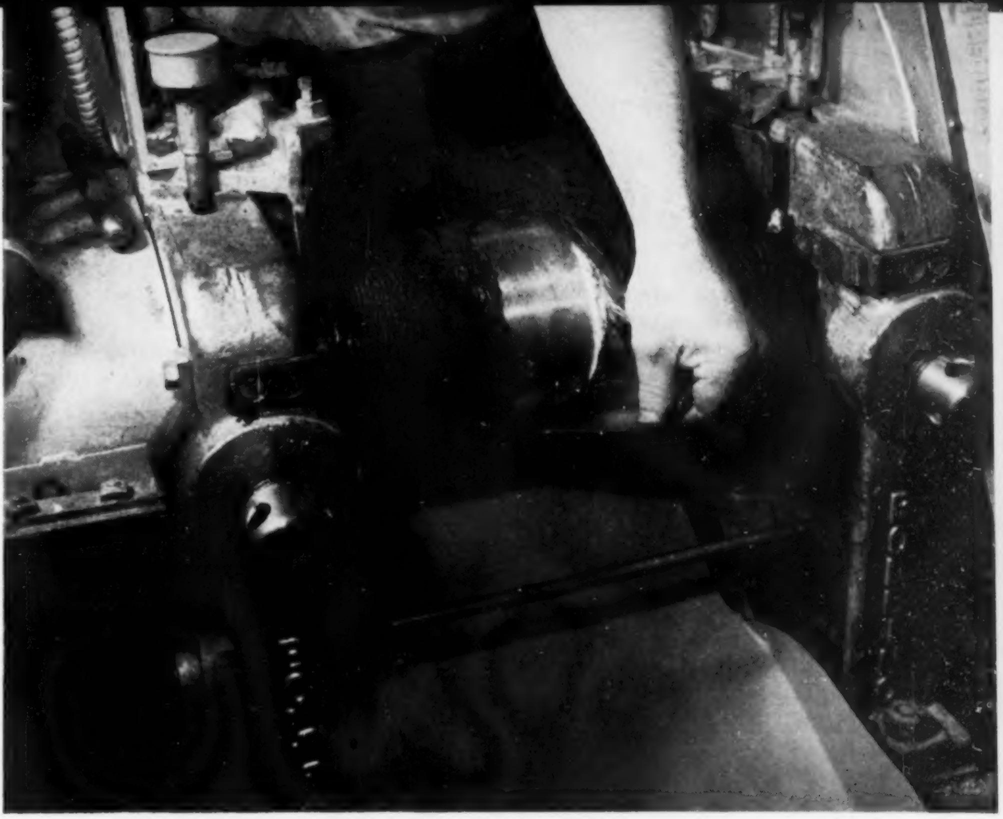
Alcohol pilot plant and other semi-commercial units at Peoria laboratory of U. S. Dept. of Agriculture



is based on the constituents of these commodities. Investigation of the commodities as a whole includes: Compositional studies to determine the effect of variety and environment; storage studies of the effect of age on the industrial processing of the commodity, with particular reference to stored corn, wheat, and soybeans; fermentation of the commodity as a whole, such as corn and wheat, for the production of motor fuels and such industrial chemicals as butylene glycol; building material investigations, using either corn stover or wheat straw as the basic raw material; production of gaseous motor fuels from agricultural residues; and economic studies on the location of surpluses and on the markets for the various new types of products.

Work of the second type, that is on constituents, is less limited and affords broader possibility and perhaps greater promise. Basic investigations are therefore being conducted on starch, glucose, proteins, oils, cellulose pulps, lignin, and hemicelluloses. So much information is already available in these fields of research that a logical basis is provided for developing new lines of attack. In some cases a particular constituent is studied using different tools, i.e., the development of new and extended uses for starch and glucose involves both strictly chemical studies and fermentation studies.

Inasmuch as the main objective of the laboratory is the development of new uses for surplus commodities, most attention is being focused on problems which show hope of large-volume utilization. Since large-volume industrial utilization is usually based on low-cost production, the modification of the various constituents by cheap reagents is receiving the main initial attention. Starch is being considered both from a fundamental and practical standpoint. It is the chief constituent of corn and wheat and the largest single raw material among the laboratory commodities. Work on this constituent is proceeding on the following lines: The modification of its properties by small quantities of inorganic compounds; the production of new compounds by subjecting starch to different heating conditions; the fractionation of starch using simple physical operations for the production of film- and non-film-forming fractions; liquid-phase oxidation; high temperature, high-pressure hydrogenolysis; the evaluation of waxy cereal starches as substitutes for tapioca starch; and the development of new industrial



The rubber substitute being milled here was made from a vegetable oil at the Northern Regional Research Laboratory

uses for dextrose and its derivatives.

Another important field in which this laboratory expects to make large contributions is in fermentation—the use of bacteria, yeasts, and molds to modify the structure of carbohydrates, and so to produce new industrial chemicals. This is not a new industrial field, comprising as it does such well-known processes as the manufacture of alcohol, lactic acid and citric acid, but it is felt that the field is almost limitless and the possibility for new developments very great.

Fermentation work is not new in the Bureau of Agricultural Chemistry and Engineering, since it was started there in 1926, and has continued since that time, always growing by the development of new techniques, the devising of new equipment, and an ever-increasing knowledge of the basic principles of the field. The laboratory has one of the largest collections of industrial micro-organisms now extant, including almost all the industrially important strains of yeasts, bacteria, and molds, and this collection is one of the important facilities for the fermentation work. The fermentation field is being cultivated by means of a survey of selected groups of new organisms with a view to the discovery of more productive strains for existing fermentations, and in the hope of identifying new products. At the present time the chief attention of this Division is focused on the production of butylene glycol, which is attracting attention because of its use in the production of butadiene and synthetic rubber, and which has much possibility as an industrial chemical in other fields. (See *Chem. & Met.*, Oct. 1942, page 95.)

Another type of fermentation and one which has attracted a great deal of attention is the production of motor fuels from agricultural products. Based primarily on the carbohydrates in agricultural raw materials, the work on motor fuels will play a large part in the operations of the laboratory. The plan of work includes studies on the availability and cost of raw materials, the saccharification of starch and cellulose by different methods, the fermentation of the saccharified product to yield various types of motor fuels, and the study of these motor fuels in suitable equipment with a view to determining their industrial use. One of the outstanding facilities of the laboratory is an alcohol pilot plant thoroughly equipped, with a capacity of 500 gal. daily. This plant will be used primarily in the production of alcohol by different methods and from different raw materials, but can also be adapted to the manufacture of other fermentation products.

The work on oils and fats assigned to the Northern Regional Research Laboratory is concerned chiefly with a complete investigation of the polymerization phenomena of soybean and corn oils and their component

fatty acids. This work, fundamental in approach, has already led to the development of a series of synthetic drying oils and resins, and an elastic, vulcanizable rubber substitute called Norepol. These products are of especial importance at the present time as substitutes for more critical war materials, and also because of the ever-increasing acreage of soybeans grown on American farms.

The investigation of proteins and their possible industrial utilization is an important part of the research program of the laboratory. Certain forms of fibrous animal proteins, e.g., leather, wool, silk, and hair, have, of course, long been extensively employed in the arts and industries, but the great available reservoir of the soluble extractable vegetable proteins, such as those which occur in corn and soybeans, has scarcely been tapped for industrial purposes. When we further consider that proteins are the largest and best source of natural nitrogen compounds, and that their properties are peculiarly different from those of the two other great classes of animal and vegetable components, namely, the fats and carbohydrates, it appears that the industrial utilization of protein has not been developed to the degree that might be expected. The work of the Northern Laboratory will concern itself with the use of corn and soybean proteins in the form of plastics, artificial fiber materials, sizing, adhesives, binders, protective coatings, etc.

Of the 100 million tons of agricultural residues, such as straws, stalks, bagasse, hulls, cobs, etc., probably available annually on the farms of the United States for industrial purposes, only about 1 percent, or slightly more, is used now for industrial purposes. For example, about 700 thousand tons of wheat straw, together with some rye and oat, are used for the manufacture of corrugated strawboard paper. Other instances are the use of sugarcane bagasse in the production of Celotex, and flax straw in the American cigarette paper industry. If one reviews the work done on the subject of agricultural residues utilization, one is impressed by the very fragmentary way in which the problem has been attacked. No organization has really been in a position to meet the problem in such a way that more than partial success with specific residues could be expected.

The approach of the Northern Regional Research Laboratory to residue utilization may be said to be an attack on four fronts. The first, an improvement in the economic problem, involves collection, transportation and storage. The farm equipment manufacturers, the State Agricultural Experiment Stations, and certain large industrial users of residues are effectively combining their points of view and efforts to meet the situation. Already definite progress from this angle has been made. In the attack on the second front, that of cellulose utilization, it becomes evident that the fiber-producing residues must be studied from the standpoint of the outstanding fiber characteristics which can be produced from a specific residue, and that these specific properties must be utilized. The entire technology of pulping agricultural fiber to produce high-grade cellulose pulps is obsolete as compared with present-day pulp technology for woods. A revision of these methods and their adaptation to certain pulps which can be used to impart specific values to specialty papers, which cannot be so readily and so economically obtained from wood fibers, will logically lead agricultural residues to their place in a comparatively high-price market.

Since less than half of the agricultural residues is comprised of cellulose, it would appear obvious that the economic situation for producing cellulose pulp from such fibers should be considerably enhanced if values could be obtained from the lignin produced in the cooking liquors. Thus, lignin is the third of our four fronts. This laboratory has shown that lignin properly isolated from agricultural residues is a valuable constituent for the production of plastics, and that by its use as hydrolized lignin, plastics of desirable flow properties can be made. Hemicelluloses are the third important constituent of agricultural residues. With the exception of the manufacture of furfural, there is practically no industrial utilization of the hemicelluloses. This is our fourth front—an unexplored field which should be capable of yielding useful results.

Facilities in the laboratory include personnel and equipment for routine analysis and analytical research for obtaining such agricultural and economic data as may be necessary to evaluate the availability and quality of agricultural commodities with respect to the effect of these factors on possible industrial utilization. Economists and statisticians cooperate with the chemists and engineers in interpreting data collected on economic and marketing factors which may effect the commercial utilization of the products or processes developed by the laboratory.

A most important facility in the Northern Laboratory is the pilot-plant wing. In the past many valuable industrial processes have been developed from research conducted in the governmental laboratories, but with few exceptions they have been presented to industry in the form of chemical data based on results from the test tube and the beaker. There is a vast difference between the technical value of laboratory work performed in glassware with laboratory techniques and laboratory material, and that carried out in a pilot plant with industrial raw materials, full-size apparatus, and employing factory techniques. One of the great values of the Northern Regional Research Laboratory to the industry of the area lies in the publication of industrial data on the processes discovered by it and obtained from pilot-plant operations.

An attempt has been made in the foregoing to describe the facilities, both mechanical and intangible, of the Northern Regional Research Laboratory. When the program of the laboratory was formulated, the United States was at peace, but it was evident that in a world at war, the probability of a continuation of peace was far from likely. The program was therefore so conceived that by a shift in emphasis rather than by drastic change, the laboratory could be placed upon a 100 percent war basis. That this has been done is evidenced by its outstanding projects at the present time. Butylene glycol, produced by fermentation, is under consideration as a source for butadiene. Norepol, a polymerized vegetable oil, is a rubber substitute which is attracting marked industrial attention in all fields of rubber use, but especially in those outlets where its deficiency in tensile strength and elongation are not of the utmost importance. Penicillin, a potentially valuable therapeutic agent, is being produced by the action of molds on sugar. Agricultural residues are being utilized experimentally in the production of crown seal cork closure substitutes and lignin plastic bottle caps in a way to attract widespread industrial interest. These are a few examples which demonstrate the value of the Northern Regional Research Laboratory in the utilization of the agricultural raw materials of its area and indicate the place that it intends to fill in the development of the Middle West.

Rehabilitating Idle Plants in the Middle West

UNUSUAL RESOURCEFULNESS has recently been demonstrated in Iowa as two idle plants have been rehabilitated and converted to more essential production. One was a bankrupt brewery at Clinton that within the past few weeks has begun to make industrial alcohol from corn. The other was a beet-sugar refinery at Waverly that had been closed for nearly a generation, but now, with the help of New York capital and experienced management, is being readied to help offset the current sugar shortage.

Last February a group of Iowa men got together and purchased the "Gateway" brewery in Clinton, a city of about 26,000 up the Mississippi River from Davenport, and which, incidentally, is also the site of duPont's $7,000,000 Cellophane plant. These men formed the Clinton Products Co. and set about to accumulate the necessary materials and equipment for alcohol production. Fortunately the plant was in excellent shape, having been in full production up to a few months before the conversion started. It contained ample fermenting tank capacity, adequate storage facilities for grain and mash, elevators, refrigeration and the usual plant services. But it lacked grinders, dryers, presses and, last but far from least important, the proper fractionating columns.

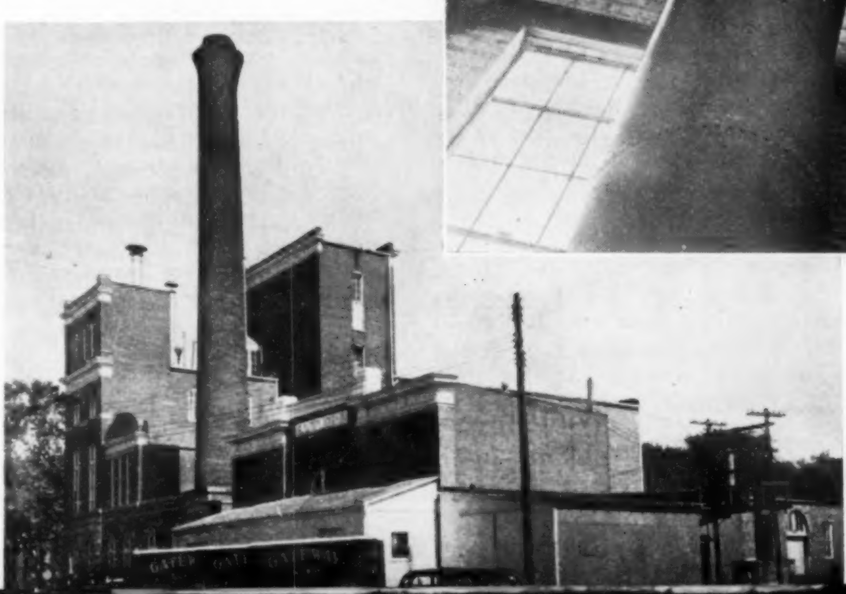
Without adequate distilling equipment, of course, an alcohol plant could not function. Looking around the country, one of the officers located a large copper still in a nearby city. It had never been used although a special fireproof building had been erected to house it. This had to be torn down, the still taken apart, shipped to Clinton and reassembled on the new foundations of the building shown in the accompanying illustrations.

On October 23, in the presence of distinguished visitors, United States Senator Clyde L. Herring appropriately dedicated the new alcohol plant by breaking a prize ear of Iowa corn on the top of one of the reconstructed stills. Production started and is expected to reach a rate of 6,000 to 10,000 gal. per day within the next few weeks. If all goes well, this plant should contribute at least 2,000,000 and perhaps as much as 3,500,000 gal. of industrial alcohol to the war program.

The sugar program is different but also has a happy ending. In April, 1941, A. M. Kahn, president of the Consolidated Products Co. of New York, bought from the American Sugar Refinery the plant and all of the capital stock of a long abandoned beet-sugar refinery at Waverly. In accordance with his company's usual practice, it was his intention to dismantle the plant and sell the used equipment for which there is now an unusual demand. He became convinced, however, that at this particular time an *operating* beet sugar plant would be of great value to the local community and to the country.

Mr. Kahn decided to forego the quicker profit and to join with others in an effort to reorganize the plant and start it going again as an operating concern. An experienced beet-sugar refiner, a refugee from Central Europe, became interested and the New York company turned over the land, buildings and equipment to his management. Further, it put up money for modernization and working capital—in short, took an active part in rehabilitating a necessary industry that should contribute its share to the war effort.

These two examples of resourcefulness in the present emergency are typical of the chemical enterprise and enthusiasm that is spreading rapidly throughout the Corn Belt.



Above—Copper condensers and still which were dismantled and transported to Clinton, Iowa. Left—The brewery as it appeared before conversion to a plant for production of industrial alcohol

Chicago Equipment Preview

Chem. & Met. INTERPRETATION

November 24–29 are the dates for the second National Chemical Exposition, to be held at the Hotel Sherman in Chicago. At the first of these expositions, in 1940, the attendance was more than 25,000. Now, with twice the exhibit space, high hopes for even larger attendance are held by the Chicago Section of A.C.S. which arranged and sponsored both expositions.—*Editors.*

COMBINATION of a program of papers on currently important matters, a symposium on the electron microscope (the first of its kind), and an exposition in which are numbered more than 100 exhibitors, is expected to make the Hotel Sherman in Chicago the goal of many chemical engineers and chemists during the last week in November. The dates, November 24 to 29, are those of the second National Chemical Exposition, sponsored by the Chicago Section of the American Chemical Society.

Another important feature will be the exhibit of the Industrial Salvage Section of W.P.B.'s Conservation Division, which is putting on a campaign to salvage, or at least to prevent the waste of, about 100,000,000 lb. of essential chemicals. Leading chemical concerns are co-operating in a comprehensive educational display dealing with the recovery, re-use and salvage of important oils, solvents and chemicals which in the past were often discarded before absolutely necessary, or used inefficiently.

In addition to the electron microscope symposium on Thursday evening and Friday, the technical program will include a group of papers on Wednesday afternoon dealing with plastics, paper and paper materials. Friday afternoon a second group will be keyed to the theme of food in relation to the chemistry of plants and soils. Friday evening will offer papers on the cyclotron in research, and on Thiokol synthetic rubbers. Closing the technical sessions, on Saturday afternoon, will be a symposium on industrial problems in wartime, including such subjects as control of incendiaries, industrial waste treatment, and chemical salvage and conservation.

A worthwhile feature which will continue through the Exposition is a program of industrial motion pictures including nearly 30 different subjects. Most of the subjects are chemical in nature, a few metallurgical and several are of general interest, dealing with industrial hygiene, lumbering and fire fighting.

For most visitors, the part of the program of greatest interest will be the Exposition itself which is planned to emphasize new materials, new methods, equipment and procedures. A measure of the interest for visitors in different categories can be gained from a breakdown of the exhibitors made as this preview goes to the printer. At that time, of the exhibitors already assigned to space, 50 planned to show plant-scale equipment; eight materials of construction for plant and equipment; six industrial and plant control instruments; 18 chemicals; 21 laboratory apparatus and supplies; and five books and magazines.

As has been done with New York Chemical Expositions in the past, *Chem. & Met.* has asked exhibitors to tell us what they were going to show in the way of new plant-scale equipment, measurement and control instruments for plant use, and materials of construction. A characteristic of this exposition which is unavoidable in wartime is the fact that many exhibitors will find it impossible to show their newest products, some of which are being held for introduction in the immediate post-war period, while others are necessarily secret and are unavailable for showing. Wartime transportation difficulties is one reason why many exhibitors will have to leave their heavy equipment at home, substituting scale models, blue prints and

photographs. Nevertheless, exhibitors in general anticipate being able to show enough to make their exhibits decidedly worthwhile.

The place of aluminum bronze as a construction material for chemical plant use will be emphasized by Ampco Metal, Inc., in its display. The exhibit will point to the company's new plant capacity for making castings to 25,000 lb., and for extrusion of rods and heavy-wall tubing. New flux-coated aluminum bronze welding rods for high strength welds will be on display.

In addition to a variety of laboratory glassware including special alkali-resistant, fritted and 96 percent silica types, Corning Glass Works plans to show industrial glass such as the Nash Pyrex pump, Pyrex pipe, fittings, gage glasses, sight glasses and numerous industrial glass parts.

Uses of its products in the manufacture of materials essential to the war effort will be stressed in the display of the Dicalite Co. This concern's filter aids, fillers, insulations, admixtures and adsorbents are being used both as production tools and in the replacement of scarcer materials. The display will show not only what the company makes, but also some of the materials into which these products go.

The exhibit of the Dorr Co. will emphasize three phases of the company's activities: its place in supplying equipment for the production of the strategic metals: aluminum, magnesium, nickel and manganese; the company's developments in the substitution of less critical for more critical materials; and finally, one of its latest equipment developments, the Hydro-Treater, a new self-contained water treatment unit.

Filter Paper Co. will show paper, cotton and glass filter materials, filter aids, filtering equipment and tanks of glass-enameled and stainless steel. The emphasis will be on new applications.

To an ever greater extent, electronic devices are being employed to increase accuracy and minimize moving parts in plant and laboratory instruments and apparatus. One exhibitor who will stress this fact is Fisher Scientific Co. who will show electronic apparatus for titration, analysis and colorimetry.

The versatility of a machine which is basically a hammer mill will be demonstrated in the booth of the W. J. Fitzpatrick Co. This concern's Model D comminuting machine can be used for pulverizing, granulating, dispersion and mixing. It is flexible in speed, easily cleaned and readily portable.

A variety of chemical stoneware including pumps, valves, pipes and containers will be exhibited by the General Ceramics Co. The display will emphasize standard designs which are being used in place of strategic materials. The company's recently developed porous electrolytic diaphragms will be among the products shown.

Packing, feeding and mixing equipment will be the principal products shown in the booth of B. F. Gump Co. Included are rotary sifters, wing-type feeders for dry chemicals, net weighers, and vibrating barrel packers.

Industrial irradiation has become increasingly important with the onset of wartime food problems. Consequently, Hanovia Chemical & Mfg. Co. plans to emphasize the latest developments in mercury-arc ultraviolet-ray equipment, such as that used in vitamin D production, as well as in water sterilization.

Plastics, to an ever greater extent, are being called upon to take the place of metals as the later become ever scarcer. Haveg Corp. expects to show numerous examples of the substitution of plastics for critical materials. New developments to be exhibited will include plastics resistant to strong acids and caustics, as well as the new Haveg-Saran plastic pipe and tubing.

Users of electric furnaces will be interested in the exhibit of K. H. Huppert Co., which will exhibit both production and laboratory size furnaces, for a multiple range of temperatures, equipped for both manual and automatic control.

A newcomer in the field of chemical porcelainware, Illinois Electric Porcelain Co., will present its first exhibit of a line of porcelain pipe, fittings, valves and tower packings. Pipe and fittings come in sizes from 1 to 6 in., and valves, 1 to 4 in.

Electrical conductivity has been used as the basis of most members of a line of plant and laboratory instruments which will be shown by Industrial Instruments, Inc.

A variety of developments in water treatment are to be shown in the booth of Infilco, Inc., formerly International Filter Co., including this concern's Accelerator process for solids precipitation, anion and cation exchange materials, and equipment for using them industrially, as well as a variety of silica gels and gel catalysts.

Tools for both maintenance and new work will be exhibited by the Insto-gas Corp. which manufactures gas-heated torches and furnaces. The gas supply is a bottled petroleum gas in small containers, available from local distributors. A new torch to be shown is intended specifically for lead burning.

An idea of the extent to which a variety of corrosion resistant metals and alloys can be welded for process equipment will be given by the exhibit of the Leader Iron Works, which will also portray the broad range of fractionating equipment, kettles, vessels and heat exchangers made by this concern.

Among other exhibits of the Loeb Equipment Supply Co. will be filters, mixers and filling machinery.

Various points of superiority claimed for the tape-type watchman's clock will be demonstrated by the exhibit of Morse Magneto Clock Co. A tape, which is moved positively to the next position by the watchman's insertion of the key at each station, is automatically printed by this act with the station number and exact time.

Several types of chemical feeding equipment, both volumetric and gravimetric, will be found in the booth of Omega Machine Co. For example, a belt type gravimetric feeder will be in operation, feeding quick lime into one of this company's continuous lime slakers, while a small volumetric feeder will be shown, driven by a unique type of variable speed transmission.

The exhibit of the Pfaudler Co. is planned to emphasize the ability of glass-lined steel equipment to eliminate undesired metal-catalyzed side reactions, and to show in general the part that such equipment is playing in war production.

Four different types of steam traps will be shown by Sarco Co., Inc., including thermostatic high and low pressure, float-thermostatic and bucket. The company's temperature regulators and pipe-line strainers will also be on display.

To demonstrate filter operation with diatomaceous filter aids, Sparkler Mfg. Co. will have a glass-walled laboratory filter in operation and will also display electric and steam heated analytical filters and stainless production filters.

An interesting new thermostatically adjusted volumetric drum filler will be shown by the National Meter Div., Pittsburgh Equitable Meter Co. The device consists of a posi-

(*Please turn to page* 176)

Silicosis: Occurrence and Control

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Chem. & Met. INTERPRETATION

In this article the author, dealing with the chemical engineer's role in controlling fibrosis-producing dusts, presents the third of his installments on combating chronic poisoning in chemical operations. Next month's article, which will deal specifically with industrial toxic solvents, will conclude the series.—*Editors.*

Silicosis should be of particular interest to engineers because the control is chiefly an engineering problem. The chemist also has an interest since the problem of detecting the hazard is partly a chemical one. Medical science has accomplished much in the diagnosis and description of the various stages of silicosis. The medical profession can give logical explanations of the action of silica in the lungs, but at the present the physician can do little for the silicotic with tuberculosis except to estimate the number of months he may live. Inasmuch as silicosis is a progressive incurable condition, the engineer is the one person who can accomplish much in its control, since dust production is generally the result of poor engineering practice.

Silicosis is a condition of the lungs caused by the breathing over a period of years dust containing silica. This condition results in: (1) lessened capacity for work; (2) shortness of breath; (3) increased susceptibility to tuberculosis; (4) characteristic early X-ray findings; (5) a progressive condition not dependent on continued exposure; (6) inability to combat tubercular infection once acquired.

STAGES OF SILICOSIS

Silicosis may be divided arbitrarily into three stages for purposes of discussion. These do not represent definite divisions, but are more in the nature of an expression of the gradual development of disability.

In first-stage silicosis the man may appear and feel quite well and show only a slight shortness of breath. This early type is generally detectable only by X-ray. The chest plates show characteristic mottling due to fine nodules of fibrous tissue.

In the second stage, although the man may be healthy in appearance, his ability to work is affected. His chest expansion is decreased and he becomes short of breath on exertion. The X-ray shows mottling due to slightly larger nodules than was the case with the first stage. It is also possible that there may be some joining of the nodules.

All of the symptoms of first and second stages are further developed in the third stage. On slight exertion there will be a decided shortness of breath. The ability to work is decreased, there is a loss of flesh and a frequent cough. The X-ray shows a more intense mottling as the nodules are larger and combine to show dense areas.

Silicosis as ordinarily encountered is an attempt of the body to counteract the inhaled silica. It is not, as some believe, a gradual filling up of the lungs with dust. The stage of silicosis which may develop depends on: (1) concentration of dust; (2) composition of dust; (3) size of dust; (4) length of exposure; (5) date of exposure; (6) individual susceptibility.

In any exposure to dust, the amount in the air at the breathing zone of the worker is important. Generally speaking, a concentration of five million particles per cu.ft. of silica dust will not cause silicosis even if inhaled over a long period of time. A concentration of 50 million particles per cu.ft. is considered excessive even if the exposure is to one of the so-called innocuous dusts.

DUST COMPOSITION

Percentage of silica in the dust has a bearing on the rate at which silicosis develops. Dusts containing under five percent free silica are considered harmless in concentrations under 50 million particles per cu.ft. Dust containing 35 percent free silica, such as granite, has a safe limit of 15 million particles per cu.ft. It is sometimes considered that the allowable dust concentration varies inversely with the free silica content. Considerable investigation has been made into the modifying effect of other dusts on the effect of silica with the hope of finding a preventative for silicosis. The investigations were based at first on the examination of dusts where the silicosis rate was low in spite of a high exposure to silica. It was found that aluminum dust had a very marked effect on the solubility of silica in laboratory experiments and on the silicosis rate in animals. The method has been tried on men and offers much encouragement.

Small quantities of metallic aluminum dust almost completely prevent a solution of silica. For example, one gram of 325 mesh quartz when allowed to stand in 100 c.c. of water, showed 50 p.p.m. of dissolved silica as compared to 1.9 p.p.m. when one milligram of fine aluminum dust was added. Animals dusted with quartz to which less than one percent aluminum had been added showed practically no fibrosis, while control animals dusted with quartz only developed silicosis.

Large particles are harmless since they tend to settle out of the air or are caught in the upper part of the respiratory tract. It is sometimes considered that the harmful dusts are between 0.5 and 3 microns in size.

LENGTH OF EXPOSURE

In an exposure to granite dust having a silica content of 35 percent, men developed first-stage silicosis in four years and second-stage silicosis in nine years when the concentration was 60 million particles per cu.ft. Perhaps one of the shortest exposures to develop silicosis was one in the manufacture of a hand abrasive soap. In one year the man developed third-stage silicosis and died in a short time. It is possible that the other ingredients of the soap may have been instrumental in hastening the action in this particular case.

Unfortunately, silicosis may continue to progress after the worker has left the exposure. We have record of a case which developed thirty years after the exposure terminated. The workman, beginning at the age of fifteen, worked for ten years at an extremely dusty grinding operation using sandstone wheels. The sandstone wheels were eliminated and the work was done for thirty years with exhausted wheels containing no free silica. At the age of fifty-five the man was found to have third-stage silicosis although he had not been exposed for thirty years.

These and similar cases indicate that the condition produced by the inhalation of silica dust is progressive. Hill reports on a group of 278 cases of very early cases of silicosis. Six years after they were removed from exposure 171 had died. Seventy-five percent of the deaths were caused by silicosis and tuberculosis. It has also been stated that life expectancy of silicosis associated with tuberculosis is eighteen months. Death may occur within a year and it is rare the patient lives over three years.

OCCURRENCE

Silicosis generally results from operations involving grinding, polishing, mixing, cleaning, pulverizing or drilling. The operations all tend either to produce fine particles or to disseminate in the air fine dust produced on other operations. The hazard, of course, will depend on the nature of the materials being handled and the amount of silica. Quarrying and finishing of granite for monumental stone produces a serious occupational disease hazard unless the greatest of precautions are taken. Similar operations with marble or limestone are considered non-hazardous from a health standpoint because of the much lower silica content.

Dry grinding operations when sandstone wheels were more generally used were especially hazardous. A number of metal polishing compounds contain appreciable amounts of silica. Unless the buffing or polishing wheels are exhausted the operation has a dangerous exposure. Typical of the exposure in mixing operations would be the manufacture of certain abrasive soaps, or wood fillers. The preparation of molding sand after the shakeout may be one of the severest exposures in foundry operation.

In a foundry where used sand was worked over with a sand cutter without adequate wetting of the dry sand, we have obtained concentrations as high as 300 million particles per cu.ft. Such exposures approach the point where the worker might be nearly drowned by the dust in the air.

Six men out of eight working for a contractor doing tile laying were found to have developed silicosis in five years. It was found that they did some dry polishing using a polishing material high in silica. An investigation, however, of the methods used by contractors in the field revealed that this was one of a very few who did dry polishing work.

In the control of the silicosis hazard, it is necessary to recognize the existence of the exposure and also to evaluate its severity. Unfortunately, this is not easy to do and it is necessary to employ techniques not ordinarily used in the chemical laboratory. It is first necessary to know the amount of free silica in the dust. In obtaining a sample, it is not sufficient to take a sample of the material being handled or processed as the dust being carried into the air may vary considerably from the original material due to difference in particle sizes or densities of the various ingredients. Rafter samples are more likely to be representative of the dust exposure, but even these may be misleading due to a difference in settling rates. Samples taken from the air over a long period by means of a vacuum cleaner would give representative samples. It is generally considered that rafter or ledge samples are sufficiently accurate if the particle sizes are uniform. An exception of this type is the type of dust encountered in a foundry. Molding sand is composed of coarse grains of silica surrounded by many fine grains of silicate. The fine particles contribute much dust because of their small size, number, and slow settling rate. However, an analysis of the original sand or the rafter sample is much higher in free silica than the dust in the air. This is because of the larger size of the silica grains which show up in the analysis but do not contribute as much in dustiness as the more numerous, smaller silicate particles.

Actual analysis is complicated by the difficulty of differentiating between free silica and silicates by chemical methods. It is necessary to use optical methods of petrography to obtain accurate information about the free silica. The refractive index can be determined on very small particles by the use of immersion liquids. This, with the information obtained under the microscope and a total silica obtained by fusion, gives a reasonably accurate picture of the free silica content.

It is also necessary to know the amount of dust in the air. Standard for the amount of dust in the air is generally based on the number of

In drilling operations, dust can be controlled by means of exhausted dust traps, as shown here. Impinger dust sampling flasks are also shown

G. A. Douglas from Gendreau, N. Y.

particles of dust per cu.ft. of air. While there are conditions where it is necessary to use this equipment to determine whether or not an exposure exists, in operations such as foundry or granite cutting, it is not necessary to run dust counts to determine the hazard because it is perfectly obvious. It is sometimes necessary to run dust counts to check on the efficiency of the equipment used to control the hazard.

The instrument on which most of the American Standards are based is the Greenburg-Smith Impinger. The air to be sampled is drawn through a tube and impinged at a high velocity on the bottom of the sampling tube. This tube contains water which wets the dust and traps it. After a known amount of air has been sampled, a portion of the liquid is removed to a suitable counting cell for microscopic count to determine the number of particles. The cell is so calibrated that it is possible by means of an eye-piece micrometer to count the dust particles in a known volume of water. The instrument is bulky because of the air pump which is necessary, but it is the nearest thing to a standard and it is possible to compare results with a considerable amount of similar work. The Konimeter and the B&L Dust Counter are two of the more common type instruments which are also used for dust determination. They are small portable instruments which are well adapted to plant control grab samples. It is possible with these instruments to take large numbers of samples and obtain information on the effect of any particular operation on dust production.

CONTROL METHODS

Control methods vary depending on the operations. One fundamental is to limit the exposure to as few people as possible. The necessity of this is emphasized by the silicosis rate of moulders in foundries. These men are exposed to dust and have a poor record for silicosis although the actual moulding operation is not dusty. The dust comes from sand conditioning work, sand blasting tumbling or from poor housekeeping. The shake-out operation is sometimes started before the molders have finished pouring and is one of the worst dust generators.

Seriousness of the dust hazard during the shake-out can be appreciated by the amount of ventilation required when large castings are shaken out. In one case reported, the castings are as large as 350,000 pounds and take fourteen days to cool. Five ventilators over the shake-out section each with a capacity of 83,000 cu.ft. of air per min. were provided to take off the dust. This particular case was unusual, but on any shake-out ventilation installation large amounts of air have to be moved. Where continuous molding and pouring is carried out, the molds are conveyed to a shake-out station and it is comparatively easy to install adequate exhaust ventilation. It is important to provide exhaust ventilation at central shake-out stations due to the large tonnage of sand handled at these points and the proximity of molders who would be otherwise unnecessarily exposed. It is possible for some foundries to have a centralized shake-out even though the mold-handling system is not utilized. This arrangement is only suitable where there is some provision for transporting of portmolds to the central station. In many cases the control is carried out by a night gang that does the work after the molders have left the plant. It is necessary to equip these men with respirators.

In drilling operations, it is possible to control the dust by means of exhausted dust traps or by using wet drilling methods. The wet method has the disadvantage of introducing a serious slipping hazard, particularly in northern stone quarries during the colder months. It has been found that the exhausted type of dust trap makes for more efficient drilling. The trap merely consists of an exhausted cone which fits over the drill and removes the dust. Tests indicate faster drilling and less sharpening of the tool due to the cuttings being quickly removed from the hole and not being ground up to fine sizes.

NECESSARY PRECAUTIONS

Sandblasting is a particularly hazardous operation because of the high concentration of dust to which the operator is exposed and also to the fact that the air is used under high pressure. The contamination is likely to stretch for some distance. The dust exposure may be as high as 241 million particles per cu.ft., although the accepted safe limit for this exposure would be about five million particles per cu.ft. This indicates the necessity for the use of positive pressure helmets and it has been found that with this type of protection (giving the worker a positive supply of six cu.ft. of dust-free air a minute) the exposure of the workmen will be reduced to around two million particles per cu.ft.

Work should be isolated in a room which is exhausted. The exhausted air is discharged through a cyclone in an isolated location or is filtered if there is any chance of the air reentering the plant. Exhausts are desirable to maintain a negative pressure in the sandblast chamber to prevent the dust from leaking out. In addition, the operator should wear a positive pressure helmet. On some jobs the control is carried still further with steel shot being substituted for sand. On operations such as stone crushing, the hazard is best controlled by making the work as nearly automatic as possible. Dust producers are enclosed so as to prevent the escape of dust into the air. Any workmen who enter the dusty location are equipped with respirators. Respirators are only intended for emergency use or for short exposures. It is much better practice, if a man is required to work continuously in one area, to control the dust hazard by enclosure, exhaust ventilation or by substituting some non-hazardous material, if possible, rather than to require use of a respirator continuously.

In addition to silica, asbestos has been found to produce a fibrotic condition of the lung. The action is different from silica in that apparently there is no tendency toward tuberculosis. The condition developed by asbestos is a heart condition which is not curable and is likely to result fatally. Exposure to asbestos dust is limited to a much smaller group than those exposed to silica.

In the case of silica, an exposure may exist without the operators being aware of the hazard. It is for this reason that we have emphasized the serious results of the exposure and the steps necessary for its control. Silicosis can be best prevented by the removal of dust at the point of origin and control measures should be based on this principle.

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Middle West Contributes New Starch Supplies

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Chem. & Met. INTERPRETATION

Starch-using industries require tuber-type starches for certain purposes and prefer them for many more. Interruption of supply from the Netherland Indies of cassava and tapioca starch has caused considerable difficulty. American starch processors are making up this shortage by modified corn starch and by new types of cereal starches which behave like tuber starches. The Middle Western states have an important part in solving these problems through new agricultural developments and new starch manufacturing methods which are here described and interpreted. —*Editors.*

INDUSTRY uses two major types of starch. Most used is the cereal starch ordinarily made from corn. Important for certain other uses is tropical or tuber starch which in peace-time comes principally from cassava, as tapioca starch. Shortage of this tuber-starch supply causes most of the scurry and the worry among producers and users of industrial starches.

This summary of the situation undertakes to explain why various people especially in the Mid-West are interested, and why the problems of starch supply have become so acute recently. It attempts also a bit of forecast based on the plans of government and industry. However, most of the comment on the future must be considered definitely speculative because it is difficult to anticipate the extent to which current developments and research may helpfully change the relationship between starches or, perhaps, even completely solve for the present the worries of those who prefer tuber starch.

There are many varieties of starch, including the two of large industrial value. Science has not yet explained exactly why the starches from different sources are different in behavior. They all have substantially, if not exactly, the same chemical composition. The different types differ in physical characteristics and behavior during use probably because of a different structural assembly of the starch units in the molecule. Some recent work indicates that the types of starch differ partly because they have more or less highly branched groupings of the starch units in the molecule. In any event, there is some such internal characteristic of the molecules which makes tuber starch more desirable for the manufacture of certain adhesives and for certain paper, textile, and other uses. And also, in the case of certain types of tapioca for food use only, tuber-type starches are wanted as they ball up into the accustomed little tapioca particles.

About 300 million lb. per year, or a bit more, of the tropical or tuber-type starches has been used in recent peace-time years. Some of the choice which led to this usage was based on a price comparison. In other cases the choice was that of necessity, not mere preference. Estimates vary widely as to the quantity of tuber starch actually necessary, some estimating that as little as 15 million lb. per year would serve for those purposes in which the different behavior is absolutely essential, while others believe that as much as 150 million lb. may be required.

Unquestionably, there is an important advantage in the use of tuber starch to the extent of 25 to 30 million lb. per year, perhaps more. Beyond that point many users prefer the tuber type but would not be willing to pay very much, if any, price premium per pound. Certainly, above a total of 150 million lb. per year, the uses are those for which purchasers were accustomed to a price advantage from the imported starch seller, and cannot be assumed to fall very much in the necessary class.

It is well known that by modification of corn starch, it is possible to produce many of the same performance characteristics, in textile, paper, and other uses, for example, as with tuber starches. This modification costs money, and thus makes the price of modified corn starch a little higher than for the usual types. At present many of those who normally use tuber starch from imported cassava are being satisfactorily cared for in a technical sense by these modified corn starches, the only disadvantage being slightly higher cost.

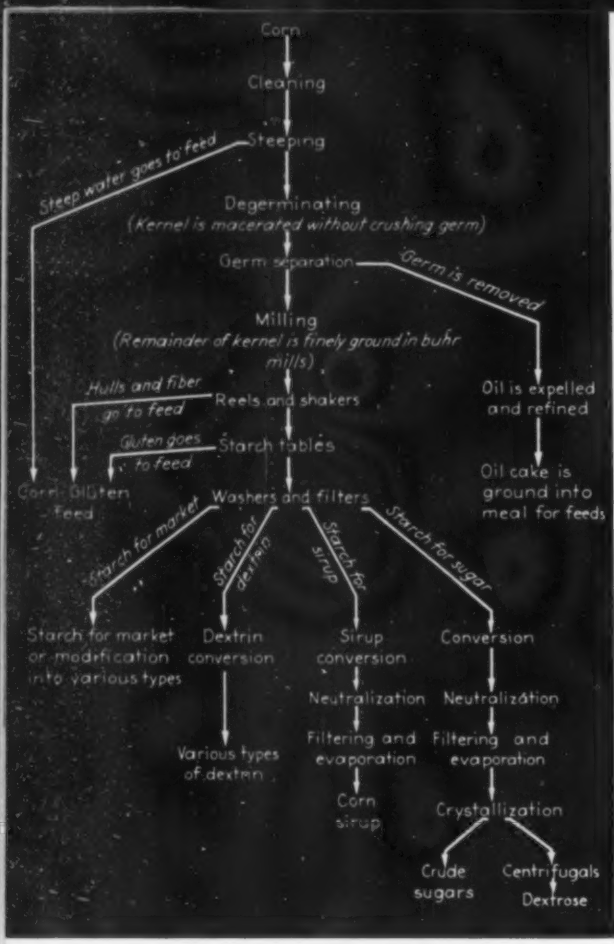
Under these circumstances, it becomes evident that the serious part of the starch supplier's job today is to get something satisfactory for a limited number of users who require perhaps 30 to 50 million lb. per year of tuber-type starch because of its preferred physical properties and performance characteristics.

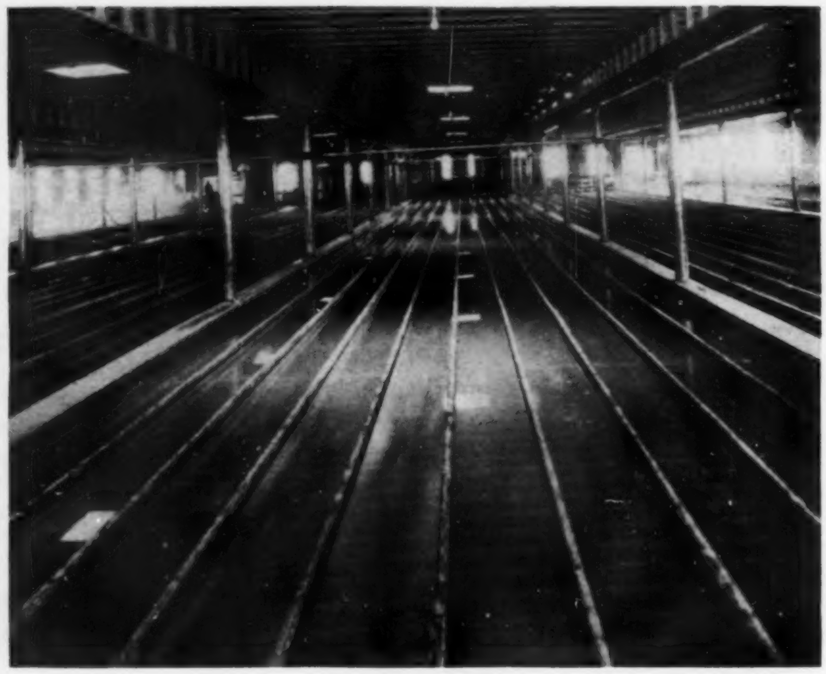
GRAIN STARCHES

In the cereal field there are certain types of waxy corn, waxy sorghum, waxy rice, and even waxy barley which produce starches having the same physical characteristics as tuber starches. However, these are definitely freaks or products of experimental breeding that have not yet been cultivated to any great extent. Definite programs to correct that deficiency are, however, now being carried out.

Waxy maize (corn) perhaps offers the greatest promise. Work has been done by the U. S. Department of Agriculture and by several state experiment stations, notably at Ames, Iowa. In cooperation with Iowa State College, a program of seed development of waxy maize has been going on for several years with the financial and industrial assistance of American Maize-Products Co.

It is hoped that several thousand bushels of seed will be available for planting in 1943. If the expected





Flowsheet shows principal steps in starch and other corn products manufacture; above are starch tables where the heavier starch is separated from gluten; both diagram and photos supplied by Corn Products Research Foundation

progress is made, there may be enough waxy maize grown that year to give us something between 10 and 30 million lb. of starch from corn which has the characteristics of a tuber starch. There is every reason to believe that this is going to be the major single contribution to the solving of the tuber starch problem; but unfortunately the starch from the 1943 crop cannot be made available in industry until about the beginning of 1944.

Certain varieties of waxy sorghum also have been developed in the United States. These sorghums have been grown normally for grain, or more commonly for forage or silage crops. They have the great advantage of being able to develop and mature on semi-arid land which is not satisfactory for most other feed crops. Hence, western Nebraska and some other areas along the edge of the Dust Bowl promise to grow waxy sorghums to a limited extent regularly, irrespective of the demand for the starch.

Apparently waxy maize can be milled into industrial starch by almost exactly the same processes as are used on normal corn for ordinary corn-starch manufacture. The minor variations in plant practice which are necessary are being developed by the industry at this time. Unfortunately, the quantity of grain which can be diverted from seed to plant experimentation is relatively small. But it does not seem likely that there will be any serious difficulty in milling the 1943 crop when it is ready. The methods, and apparently the costs, will be much like those with normal corn. The main disadvantage is the fact that the farmer does not yet get quite as many bushels of waxy maize per acre as he does of the ordinary type of maize.

The milling of waxy sorghum is quite a different matter. Starch of the desired characteristics cannot be milled from it with normal methods of the wet miller who processes corn, due primarily to the red coloring in that variety of waxy sorghum now most grown. At present the most promising outlook is for two-stage milling. First, the sorghum will be processed like wheat by dry milling to make flour or grits, thus removing the bran which carries most of the unwanted color of the seed. The flour or grits can then be converted into starch by normal wet-milling processes. Actually this procedure is being followed at the present time by one of the largest food users of tapioca starch. That firm may thus in part supply its tapioca customers with a tuber-type starch from a cereal source. The cost is higher than normal but not prohibitive when the importance of maintaining brands and types of tapioca pudding are considered.

POTATO STARCH

Many people have expected that some day the United States would have a large potato starch industry. Actually, that development has not been encouraged by economic conditions. It is not practical for American agriculture under most circumstances to grow potatoes for starch. The occasional surpluses and culls which are made into starch do not form a very satisfactory economic basis for a regular business. Nevertheless, the production of starch from white potatoes has gone on at least intermittently in this country, especially in Maine.

The manufacture of sweet potato starch has had encouragement of extended government research and there is a small regular manufacture in the United States at one or two plants in the South. Here again, economic considerations and the hesitancy of farmers to change their cropping practice have been serious causes of delay. Even under the stimulus of present war-time demand it has seemed impractical to develop our sweet potato production extensively as a starch crop. The prospective development of waxy maize rather implies that the economic considerations for a sweet potato starch industry may be less favorable in the future than in the past. Nevertheless, it is much too early to write

United States Starch Statistics, 1927-39*

	Millions of Pounds					
	1927–29†	1932–34†	1935–37†	1937	1938	1939
U. S. Production[1]						
Cornstarch						
Processed to:						
Sirup and sugar	1,973	1,605	1,483	1,539	1,524	1,549
Dextrine	121	81	92	93	89	109
Sold as starch:						
In U. S.	640	590	693	685	727	815
Exported	235	56	44	43	190	192
Total cornstarch produced	2,969	2,332	2,312	2,360	2,530	2,665
Potato starch	11	14	25	17	21	19
Imports						
Tapioca	152.4	165.5	301.4	432.9	230.9	382.8
Sago	5.6	11.5	31.6	33.5	11.8	22.8
Potato starch	24.3	12.5	10.5	10.5	6.7	11.0
All other	1.8	4.1	7.1	6.7	6.5	9.4
Total imports	184.1	193.6	350.6	483.6	255.9	426.0
Domestic starch consumption[2]						
For all purposes	2,929	2,484	2,625	2,768	2,667	2,918
Sold as such	835	798	1,050	1,135	1,054	1,260

*Source, U. S. Tariff Commission. †Yearly averages.

[1]Does not include small wheat and rice starch production. [2] For 1937 breakdown was as follows: Corn sirup and sugar, 55.6 percent; corn dextrine, 3.4 percent; food, 10.6 percent; textiles, 8.0 percent; paper, 7 percent; laundry, 5 percent; dextrines and adhesives made by non-producers of starch, 3.8 percent; wood products, 1.9 percent; all other purposes, 4.7 percent.

off the potato starch business as a whole.

The U. S. Department of Agriculture has been working on these problems intensively. However, it does not appear that the waxy maize program is going to need much official assistance. The wet grinders of starch stand ready to back that program commercially just as soon as adequate quantities of seed are available. And American Maize-Products Co. has expressed its intention to share its technologic developments with the rest of the industry as soon as commercialization becomes practical.

Nor does government cooperation in the waxy-sorghum program seem needed. Without such aid it is likely that a sufficient amount of waxy sorghum seed will be held at the end of this season. However, although it appears that some program to assure waxy sorghum growers of an adequate market may be desired next year, the magnitude and the need of such a program remain as yet altogether uncertain.

One fortunate factor develops with respect to waxy sorghum. Up to harvest time this crop may be directed either to starch manufacture or to feed usage. The maximum loss to the government in supporting the program would, therefore, be relatively small, a loss that would be negligible in comparison with the possible advantage to the country in having an additional tuber starch supply.

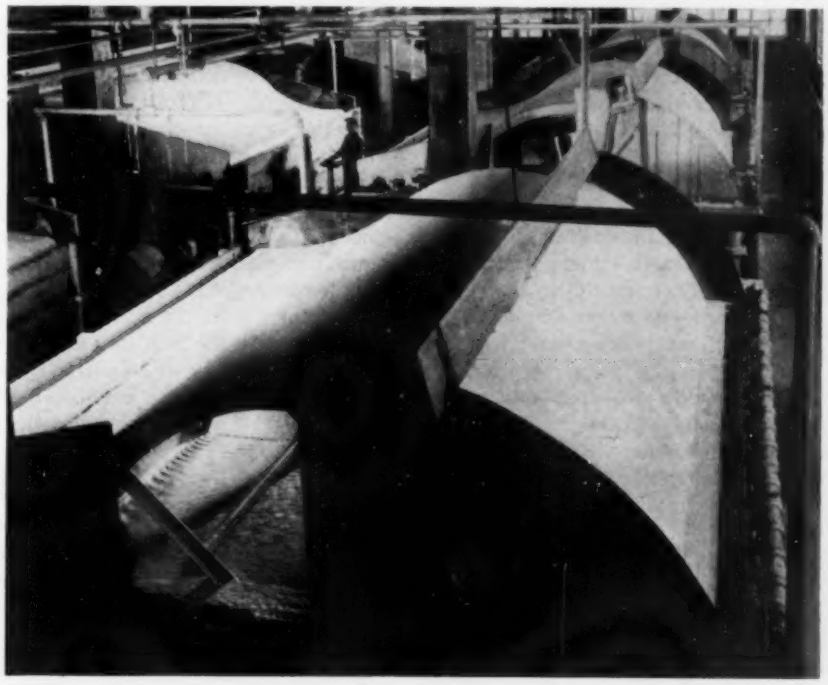
FOREIGN COMPETITION

Java and other Netherland Indies sources have been the major source of imported cassava and tapioca starch. Cost of production has been quite low, partly because of the low wage rates paid to labor. However, the situation had already begun to change before the Dutch were driven out of the East Indies. Furthermore, as wise Colonial managers, the Dutch have found it definitely a long-term advantage to establish a higher standard of living among their native workers. The low prices of cassava and tapioca characteristic of depression years may, therefore, never be re-established in the post-war period. However, no one can guess what post-war arrangements will govern; it is even conceivable that the Dutch may never again have an opportunity to re-establish the cassava industry as they now hope and expect to do.

Dutch competition has included one characteristic of substantial importance, namely, maintenance of quality standards. Export of cassava from the Indies was restricted by government action to prevent low-quality material coming to the United States, even for purposes for which a relatively high quality was not actually necessary. The Dutch officials believed that all of their cassava and tapioca starch should be applicable to any prospective use, thus protecting themselves against the disappointment of users who might inadvertently obtain a lower quality than was essential.

When the present war ends there will doubtless be abundant tuber starch production in the East Indies. Then the United States Government will be faced with the question of whether the farmers who have developed waxy corn and waxy sorghum, as well as other wartime adaptations, should be protected by a tariff. No one can attempt to guess now what the official answer will be. Some of the war-time developments will surely be superseded by re-established low cost agriculture in foreign areas. Nevertheless, American starch makers are going ahead. By research they hope to establish themselves so firmly in some of the customer areas that there will be no serious difficulty in maintaining their place after the war is over.

In large filter-type washers such as these the starch undergoes final washing



Butadiene by the Houdry Dehydrogenation Process

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Chem. & Met. INTERPRETATION

One of the recent developments in the technology of synthetic rubber is the Houdry two-stage dehydrogenation catalytic process for converting butane or butane-butylene fractions into butadiene. Herein the authors describe advantages of the process, material requirements and construction costs, as well as yields and production expenses for a 15,000 ton plant.—*Editors.*

Shortage of natural rubber caused by the war has led to the application of the Houdry process for production of butadiene. Houdry's research on catalytic processes since 1923 and experience gained in large-scale cracking and aviation gasoline plants employing his process are fully utilized in the design of Houdry catalytic dehydrogenation plants for producing butadiene.

This article deals with the Houdry two-stage dehydrogenation process for production of 15,000 tons of butadiene per year in each plant. Such a plant is now being built by Sun Oil Co. for the Defense Plant Corp. to supply butadiene to the Rubber Reserve Corp. This size plant is admirably suited for small refineries and for natural gasoline and recycling plants where a sufficient supply of butane is available. It can also be erected in natural gas fields where butane is separated from natural gas, while the balance of the de-butanized gas may be piped away for gas fuel or stored.

ECONOMY OF MATERIALS

Design of these small butadiene plants permits the use of 60-75 percent of material either existing at such plants or easily available as second-hand equipment. Sun Oil Co. has found sufficient material for construction of its plant so that of the estimated gross expenditure of \$3,254,000 only \$313,686 or 18.2 percent of this amount is represented by new critical materials requiring priority. The total weight of material to be used in this project, excluding masonry and lumber, is estimated at 6,025 tons, of which 80 percent consists of existing or second-hand equipment. Only 20 percent of the weight of the total materials entering into the contemplated construction requires priority.

Another advantage of this process and design is that such a plant can be completed and placed in operation within six months after construction begins. After the war, these plants may be converted at reasonable cost into units for production of high-octane gasoline and components of aviation gasoline.

SUPPLY OF FEED STOCK

Butane is used as charging stock, although a mixture of butane-butylene can be used and the first stage of the dehydrogenation process eliminated.

Butane, however, is preferred because it is available in large quantities in relatively pure form at refineries, as a by-product of alkylation processes for the manufacture of aviation gasoline, in natural gasoline and recycle plants. Furthermore, the use of butane does not reduce the raw material needed for the 100-octane aviation gasoline program as would be the case if butylene were used as feed stock.

A careful survey of the potential normal butane production at natural gasoline plants and refineries in the United States, based on 1941 production figures from the Bureau of Mines and data for the first five months of 1942, permits the following estimate of potential n-butane production for the current and future years up to 1944 inclusive (as bbl. per day):

From natural gas at gasoline plants....	92,000
From cracking processes at refineries...	36,700
Present in crudes run................	50,400

Normal butane is, therefore, available to the extent of at least 175,000 bbl. per day.

Due to the high yield of butadiene obtained from butane in the Houdry process, 44 plants of this type, each charging 677 bbl. of butane or a total of about 30,000 bbl. daily, can produce 660,000 tons of butadiene annually. This is sufficient for the final production of 880,000 tons of rubber, or the entire tonnage proposed at present by the Federal Government to be produced from petroleum raw material sources.

By making fullest possible use of existing equipment, an expenditure for new critical material of less than 40 million dollars would suffice to build these plants. The first 300,000 tons of annual capacity could be in operation within six to seven months and the total required capacity of about 600,000 tons within nine months after beginning of construction activities.

DESIGN OF PLANT

All Houdry plants are designed to operate on very short on-stream periods. Each on-stream period is followed by a regeneration step, whereby carbon deposited on the catalyst is removed and the catalyst maintained in active condition. The useful life of the catalyst is expected to be more than six months. Due to the relatively pure form of the charging stock the carbon deposit is comparatively small.

High yields obtained reduce the amount of charging stock required and, consequently, also the size of equipment necessary to produce a given amount of butadiene.

Operating temperatures are relatively low. Likewise, utilities, such as steam, fuel, power and water required are low and less material is needed for plant and equipment to supply them.

Equipment of the dehydrogenation unit for production of butadiene is similar to that used in the existing Houdry catalytic plants. The reactors or catalytic vessels, six in number, are of simpler design than in cracking plants.

The charging butane is subjected

Utilities Required for Houdry Combined Two-Stage Butadiene Plant and Purification Plant for 15,000 Tons per year

Electric power............	33,600 kwh/day
Fuel Oil or gas (80,200,000 b.t.u./hr.).............	309 bbls./day
Steam...................	2,000,000 lbs./day
Cooling water circulation..	10,000 g.p.m.
Makeup water for cooling..	300 g.p.m.

If process steam is first expanded through drivers, the above electric requirement may be correspondingly reduced. Electric power requirement includes refrigeration equipment. If steam or gas-driven refrigeration compressors or steam-jet refrigeration are used, the power consumption may be reduced by 18,000 kwh per day.

to dehydrogenating conditions in the reactors in two stages. The first stage yields butane, butylene and lighter gas. The butane and butylene portion is concentrated in a vapor recovery system to produce the charge for the second dehydrogenating stage in which butadiene is produced.

Heat required for the chemical change of butane to butylene and from butylene to butadiene is furnished by burning the carbon deposit on the catalyst during the dehydrogenating stages. Regeneration of the catalyst is accomplished by burning the carbon deposit by passing air through the catalyst. The reactors possess sufficient heat storage capacity to eliminate wide temperature fluctuations, and pressure and rate of flow are regulated so as to balance the heat required for the chemical reactions with the heat supplied by the burning of the carbon deposit.

Material Requirements for Houdry Combined Two-Step Dehydrogenation and Purification Plant for Production of 15,000 Tons Year Butadiene

25% added to all items for contingency

	Weight — Tons		
	Dehydrogen. & Separation	Purification	Total
Carbon steel plate	293	250	543
Structural steel	484	143	627
Reinforcing steel	63	19	82
Steel tubular material	1015	360	1375
Steel forgings	68	38	106
Forged steel valves	3	2	5
Cast steel valves	234	38	272
Cast steel castings	109	......	109
Carbon steel bolts	10	3	13
Total carbon steel	2279	853	3132
Cast iron castings	42	34	76
C. I. castings (Heat resist.)	15	......	15
Cast iron valves	25	13	38
Total cast iron	82	47	129
27% Chrome steel plate	30	......	30
Low alloy steel bolts	10	3	13
Cast brass valves	1	1	2
Brass tubing	19	......	19
Brass, bronze plates, bars	63	......	63
Copper cable and bars	16	......	16
Lead cable covering	6	2	8
Total non-ferrous materials	105	3	108
Machinery	465	60	525
(Compressors, excl. of refrigeration)	2450 H.P.	470 H.P.	2920 H.P.
Electric motors, number	4	5	9
(Excl. of refrigeration)	295 H.P.	191 H.P.	486 H.P.
Transformers, number	2	......	2
Switch gear, number	2	......	2
Instruments and controls	9	3	12
Special equip. (cycle timer, etc.)	3	......	3
Insulation	375	125	500
Welding rod —alloy	3	......	3
Welding rod — carbon steel	24	8	32

Estimated Production Cost for Houdry Combined Two-Stage Butadiene Plant to Produce 15,000 Tons per Year, Including Purification Plant

	Base Price	Quantity per Day	Calendar Day
Electric power	$0.007/kwh	33,600 kwh	$235
Fuel oil (6,000,000 b.t.u./bbl.)	1.10 bbl.	309 bbls.	340
Steam (from fuel or gas)	0.33/M lbs.	2,040 M lbs.	673
Cooling water	0.008/M gal.	10,000 g.p.m.	115
Make-up water	0.15/M gal.	300 g.p.m.	65
Operating labor:			
Process plant (10 men @ $1.20/hr.)			288
Laboratory (5 men @ $1.20/hr.)			144
Undistributed labor and supervision			100
Catalyst			165
Solvent			216
Inhibitor			10
Maintenance (excl. boilerhouse and water system) 6% of $3,036,420			500
Taxes, insurance (1% of $3,036,420)			83
Total operating cost			$2,934
Butane charge	$0.06 gal	677 bbls.	1,706
Fuel gas credit	1.10 bbl.	158 bbls.	174 (Cr.)
General administrative costs $0.075/lb. Butadiene			684
Royalty at $0.00125/lb. Butadiene			115
Total cost (excl. amortization)			$5,265
Cost of butadiene (excl. amortization) Based on 66.9% yield from butane, per lb			$0.06421

The Houdry process, so far as we know, is the only process which developed the technique of utilizing the adiabatic cycle of heat produced during the burning cycle of the carbon as the principal source of heat required for the dehydrogenation cycle.

Overall Material Balance for 15,000 Tons per Year

Fuel gas	23.6%
Catalyst deposit (burned in process)	9.5%
Butadiene	66.9%

This material balance allows for losses in butane absorber and is based on 90 percent recovery of the butadiene in the purification process.

Storage and Containers for 1, 3-Butadiene

Chem. & Met. INTERPRETATION

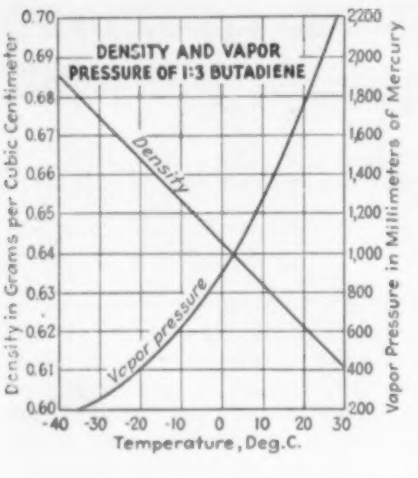
Recently the Pittsburgh-Des Moines Steel Co., through its Chemical Storage Fellowship at the Mellon Institute of Industrial Research, has undertaken a program of research to develop the best container materials, container coatings and proper storage conditions for raw materials used in the manufacture of synthetic rubber. This article is an abstract of Bulletin 7381-B reporting results of research on 1, 3-butadiene. Other bulletins are being prepared to cover the storage of styrene, iso-butylene and acrylonitrile.—*Editors.*

Any rational attempt to arrive at the most economical storage of 1, 3-butadiene necessarily involves the consideration of many variables in order to show a comprehensive picture of the entire problem. Among the more important variables are those of storage temperature, working pressure, and the type and capacity of the containers. Among the less important variables are those of density and specific heat of the liquid.

This report covers the range in temperature between 24 deg. F. and 140 deg. F. in the following steps:

Storage Temperature Deg. F	Vapor Pressure Lb./sq. in. Gage
24	0
32	2.9
70	23
100	50
140	100

The lower limit of 24 deg. F. was chosen because it is the boiling point at one atmosphere, so that lower temperatures would require storage under partial vacuum. The higher limit of 140 deg. F. was chosen because it is a probable maximum temperature to expect inside an unin-



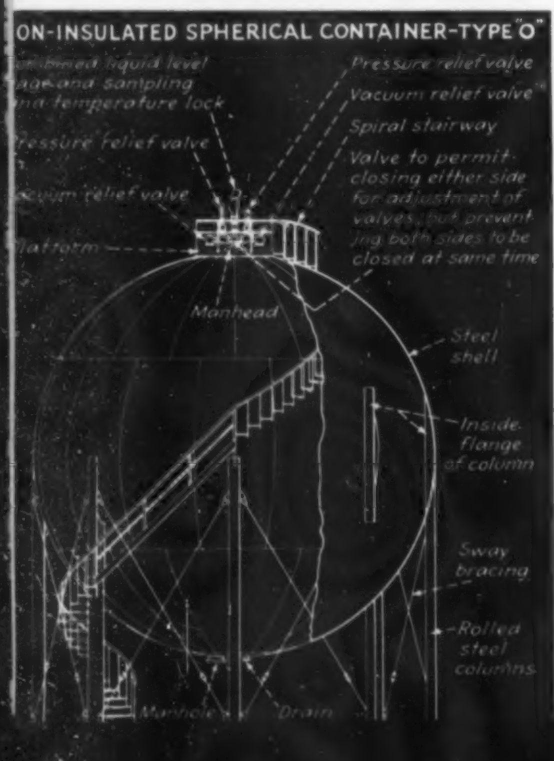
sulated container exposed to sunlight during the summer months.

Storage temperature is by far the most important variable. It has to do with: (1) working pressure in the tank, and hence the quantity of steel required for the construction of the tank; and (2) the density and specific heat of the liquid stored.

It is recommended that 1, 3-butadiene be stored as a liquid at a temperature of about 32 deg. F. and a corresponding vapor pressure of about 17.65 lb. per sq.in. absolute or 2.9 lb. per sq.in. gage in order to minimize costs and reduce losses.

TYPE OF CONTAINER

Butadiene can be stored in five types of storage containers: type "O" is an uninsulated and unrefrigerated spherical container used to store liquids and gases under pressure. Type "10" is an insulated and refrigerated container but otherwise identical with type "O". Type "45" is an insulated and refrigerated double-walled cylindrical container



with suspended bottom and dome roof, designed especially for storage of volatile liquids at working pressures under 10 lb. per sq.in. gage. Type "100" is an uninsulated and unrefrigerated horizontal cylindrical container 10 ft. diameter x 50 ft. long, used for storage of liquids. This type is used in groups of 2, 5, 8 and 10 to make up the required 100, 300, 500 and 700-ton capacities. Type "110" is insulated and refrigerated but otherwise identical with type "100".

1, 3-butadiene should preferably be stored in vapor-tight, air-free containers such as type "45", which is an insulated and refrigerated cylindrical tank with suspended bottom and dome roof, designed for a working pressure of 3 lb. per sq.in. gage.

CONTAINER MATERIAL

Low pressure containers (under 15 lb. per sq.in. gage) should be of welded construction using mild steel of A.S.T.M. specification A-10. Containers designed for pressure in excess of 15 lb. per sq.in. gage should also be of welded construction using flange or fire-box boiler grade steel of A.S.T.M. specification A-70 to comply with the A.P.I.-A.S.M.E. code for unfired pressure vessels.

It is recommended that mill scale be removed by sand, grit, shot blasting, flame-descaling, or pickling. Stainless steel or steel coated with tin would be ideal, but the added cost is not considered justified.

Accessories should be of forged or cast steel or of wrought or cast iron. Copper or aluminum or their alloys are of doubtful value.

A protective coating for the interior of the container may be used to minimize corrosion from water vapor and other impurities. Several protective coatings appear to be satisfactory and are now being tested.

CHEMICAL PROPERTIES

Most prominent chemical property of butadiene is that of dimerization and polymerization. Dimerization is apparently not catalyzed by peroxide or by the type of surface. However, polymerization is catalyzed by

Cost Comparisons for 300-Ton Storage Capacity

1. Type of container	"45"	"45"	"10"	"10"	"0"	"100"	"110"	"0"	"110"	"110"	"100"
2. Storage temperature, °F.	32°F.	24°F.	70°F.	32°F.	100° F.	100° F.	70°F.	140° F.	32°F.	24°F.	140° F.
3. Storage pressure, lbs./sq. in. gage.	3	0	23	3	50	50	23	100	3	0	100
4. Density of 1;3 butadiene, lbs./cu. ft.	40.1	40.4	38.7	40.1	37.6	37.6	38.7	36.1	40.1	40.4	36.1
5. Approximate tons steel per ton of storage capacity	0.110	0.105	0.087	0.062	0.133	0.216	0.177	0.245	0.166	0.165	0.405
6. Approximate total weight of steel in tons	33.0	31.5	26.1	18.6	39.9	64.8	53.1	73.5	49.8	49.5	121.5
7. Thickness of insulation in inches	12	12	2	5	......	......	2	......	5	5	......
8. Heat transmission, btu./degree F/24 hr	2275	2275	11020	4390	......	......	29050		11880	11880	
9. Maximum temperature differential °F	64°F.	72°F.	26°F.	64°F.	......	......	26°F.	......	64°F.	72°F.	......
10. Average temperature differential, °F	24°F.	32°F.	0.5F.	24°F.	......	......	0.5°F.	......	24°F.	32°F.	......
11. Maximum cooling load, btu/24 hr.	146000	164000	287000	281000	......	......	755000	......	760000	855000	......
12. Average cooling load, btu/24 hr.	54600	72900	5510	105300	......	......	14525	......	285000	380000	......
13. Required refrigeration capacity, tons/24 hr	0.51	0.57	1.00	0.98	......	......	2.62	......	2.64	2.97	......
14. Average refrigeration load, tons/24 hr	0.19	0.25	0.02	0.37	......	......	0.05	......	0.99	1.32	......
15. Initial costs of:											
a. Containers, accessories, foundations	$13000	$12900	$15600	$15000	$20300	$26400	$21750	$28300	$20400	$20100	$44300
b. Insulation	1230	1230	1100	2750	......	......	2920	......	7440	7440	......
c. Refrigeration plant	620	680	1000	960	......	......	1900	......	1900	2050	......
16. Total initial cost of storage plant	$14850	$14810	$17700	$18710	$20300	$26400	$26570	$28300	$29740	$29590	$44300
17. Annual operating costs:											
a. Investment charge for containers, accessories, foundations	$910	$903	$1092	$1050	$1421	$1848	$1523	$1981	$1428	$1407	$3101
b. Investment charge for insulation	82	82	135	338	......	......	359	......	915	915	......
c. Investment charge for refrigeration plant	43	48	70	67	......	......	133	......	133	144	......
d. Taxes on complete storage plant	594	592	708	748	812	1056	1063	1132	1190	1184	1772
e. Maintenance and repair	594	592	708	748	812	1056	1063	1132	1190	1184	1772
f. Supplies and miscellaneous	149	148	177	187	203	264	266	283	297	296	443
g. Power, light, fuel	64	68	51	77	50	50	154	50	121	145	50
18. Total annual operating cost	$2436	$2433	$2941	$3215	$3298	$4274	$4461	$4578	$5274	$5275	$7138
19. Annual operating cost per ton of storage capacity	$8.12	$8.11	$9.80	$10.72	$10.99	$14.25	$14.87	$15.26	$17.58	$17.58	$23.79
20. Cost ratios for 300 ton capacity containers	1.00	1.00	1.21	1.32	1.35	1.76	1.83	1.86	2.17	2.17	2.93
21. Cost ratios for all capacities considered	1.40	1.40	1.69	1.85	1.90	2.46	2.57	2.64	3.04	3.04	4.10

active oxygen wherever it is in the form of air, oxygen, inorganic peroxide, or organic peroxide.

Addition of anti-oxidant inhibits the formation of high molecular weight polymer, but has no appreciable effect on the rate of dimer formation. The rate of high molecular polymerization is directly proportional to the square root of the concentration of peroxides (active oxygen).

The temperature coefficient of high molecular weight polymerization is quite high. For a 27-deg. F. rise of temperature, the rate of polymerization increases several fold. The type of surface has no pronounced catalytic influence on dimerization. Increase of surface area has little or practically no effect on the rate of polymerization.

Vapor Pressure of 1, 3-Butadiene

Deg. F.	Lb. per Sq. In.
—137.2	0.05819
—130	0.08145
—112	0.2036
— 94	0.4364
— 76	0.8728
— 68	1.6290
— 40	2.8320
— 22	4.7900
— 4	7.6230
+ 14	11.8300
+ 24.08	14.7500
+ 32	17.6500
+ 50	25.6100
+ 68	36.8500
+ 86	51.4000
+104	70.0900
+122	93.0900
+140	124.200
+158	138.700
+176	203.700

Catalyzers include air, copper, lead, stannic chloride, metallic sodium and other alkali metals, alkaline earth metals, amalgams or alloys of these metals, colloidal platinum, mercury, silver or manganese dioxide, metallo-organo compounds, boron trifluoride, barium peroxide, hydrogen peroxide, sodium perborate, ammonium persulphate, organic peroxides, organic peracids, sulphur, starch, oleates of sodium, ammonium, and cobalt, sodium stearate, albumen, casein, urea, soap, saponine, glycerine and dioxan.

MODIFIERS

A list of the inhibitors includes tertiary butyl catechol, hydroquinone, tri-cresol, phenyl-beta-naphthylamine, diarylamines, 1, 8-diaminonaphthalene.

Among the modifying agents are carbon tetrachloride, hexachloroethane, terchloropropionitrile, sodium cyanide, mercaptans, xanthogendisulphide, thiuram disulphides and sulphinic acids.

Thickness of insulation was computed from the following equation:

$$t = \sqrt{\frac{4RT}{C}}$$

where t=economical thickness in inches; R=cost of refrigeration in dollars per ton day; C=cost of insulation in dollars per cu.ft.; and T= average temperature differential, degrees Fahrenheit.

INSULATION

Corkboard is used for the single shell containers, type "10", "110", and rock wool or similar material is used for the double shell container type "45". The unit cost of the insulation in place depends upon the type and quantity required. The cost of refrigeration per ton day depends upon the initial and operating costs of the refrigeration plant.

Average temperature differential depends upon the storage temperature and on the monthly mean temperature at the site of the storage plant. Thus for type "10" or "110" in Pittsburgh, 32 deg. F. storage:

$$t = \sqrt{\frac{4 \times 0.45 \times 24}{2.00}} = 4.65 \text{ in.}$$

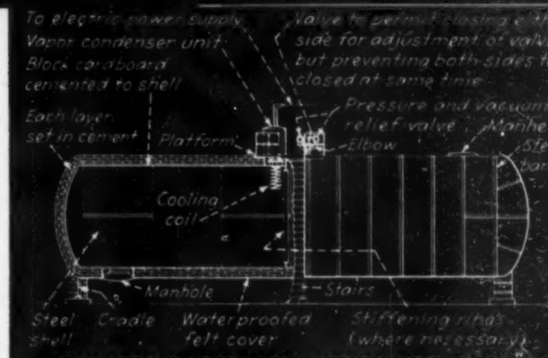
For type "45" in Pittsburgh, 24 deg. F. storage:

$$t = \sqrt{\frac{4 \times 0.35 \times 32}{0.30}} = 12. \text{ in.}$$

The thickness of insulation determines the capacity and average cooling load of the refrigeration plant since it governs the heat transmission through the container.

CONCLUSIONS

Results of this research indicate **that 1, 3-butadiene should be stored** at a temperature of about 32 deg. F. at which it has a vapor pressure of approximately 3 lb. per sq. in. gage. This conclusion is supported by the following reasons:



INSULATED HORIZONTAL CONTAINER-TYPE "10"

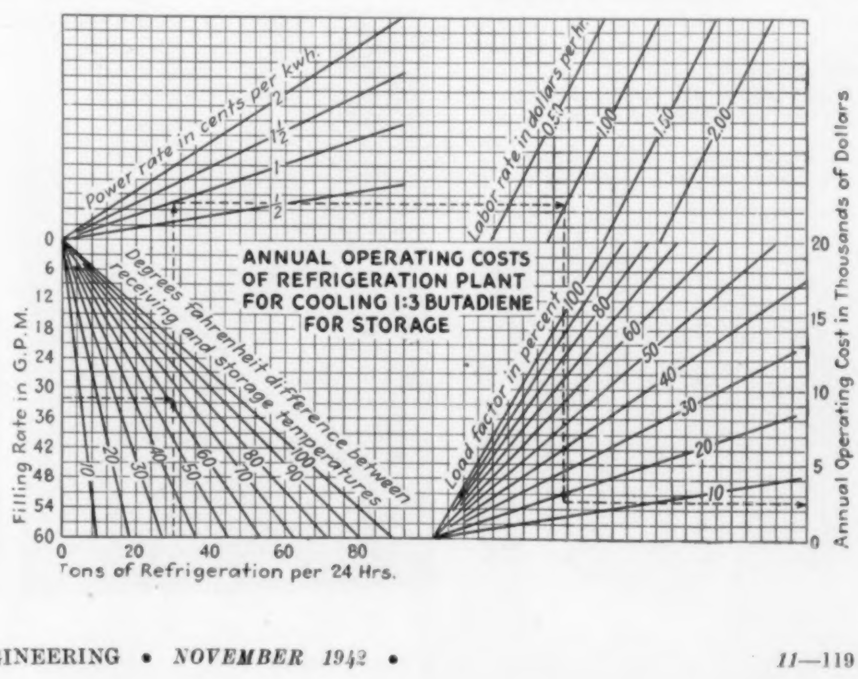
(1) The loss of product at 32 deg. F. through dimerization and polymerization is practically negligible, such loss being less than 1/40th of that occurring during storage in the usual steel containers during the warm summer months.

(2) Storage at about 32 deg. F. results in the lowest initial cost of the storage plant and also the lowest total annual operating cost.

(3) The amount of steel required for containers at the recommended storage temperature of 32 deg. F. is less than ½ of the amount required for containers in which 1, 3-butadiene is stored at ambient temperatures.

(4) The containers should be of maximum size for the total capacity involved, because within the range of capacities considered for rubber plants and the producers of synthetic rubber raw materials, the larger the container size, the lower the cost per unit of product stored.

Other bulletins, similar to the one from which this material has been abstracted, are in the course of preparation to cover the proper storage conditions and containers for styrene, iso-butylene, and acrylonitrile.



CHEM & MET

PLANT NOTEBOOK

Timesaving Ideas for Engineers

SIMPLE CHART FOR COMPUTING LOG MEAN AND COMPARING LOG AND ARITHMETIC MEANS

JOSEPH D. PARENT *Chemical Engineering Dept., Kansas State College, Manhattan, Kan.*

In order to preserve similarity of form in flow equations it is frequently necessary to introduce a function known as the logarithmic mean. Thus, one encounters the log mean driving force, area, length, resistance, pressure, etc., in equations for flow of heat and diffusion of materials. The function is defined by Equation (3).

For the sake of simplicity, the ordinary arithmetic average is often used instead of this newer type of mean, especially since the values of the two forms of means approach each other more closely as the quantities involved in these averages become more nearly equal.

There are two general graphical methods of computing the log mean of any two quantities, rapidly and accurately, without the necessity of looking up logarithms. One excellent method which has been available for some time but has not enjoyed the wide usage that it merits is the utilization of an alignment chart. An excellent one has been prepared by Lehnhardt and has been reproduced in "Fuels and Their Combustion" (Haslam and Russell, first edition, page 750, McGraw-Hill Book Co., Inc.). A second method which is presented in this paper consists simply of calculating the arithmetic mean and applying a correction or conversion factor. It is developed as follows.

Where M_A is the arithmetic mean, M_L is the logarithmic mean, X is a correction factor, ln is the symbol for natural logarithm, A is one of the quantities involved in the calculation of the mean, B is the other quantity involved (B is taken as the smaller of the two), and r is the ratio A/B:

$$\text{Let } M_L = X \times M_A \qquad (1)$$

$$\text{where } M_A = \frac{A + B}{2} \qquad (2)$$

$$\text{and } M_L = \frac{A - B}{\ln A/B} \qquad (3)$$

It follows that:

$$\frac{A - B}{\ln A/B} = \frac{X}{2}(A + B) \qquad (4)$$

whence

$$X = 2\left(\frac{A - B}{A + B}\right)/\ln A/B \qquad (5)$$

or

$$X = 2\left(\frac{A/B - 1}{A/B + 1}\right)/\ln A/B \qquad (6)$$

$$\text{if} \quad r = A/B \qquad (7)$$

then

$$X = 2\left(\frac{r - 1}{r + 1}\right)/\ln r \qquad (8)$$

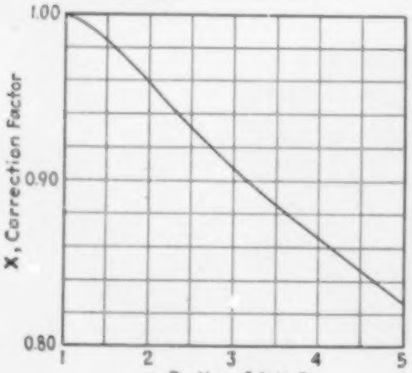
If desired, ln r may be expanded in a suitable series and Equation (8) may be reduced to a purely algebraic expression.

One is now in a position to calculate values of X for various values of r and plot a curve involving these two variables as in the accompanying chart. Given this graph, the calculation of the log mean of two measurements or values, A and B, consists of calculating r and M_A, and reading off and applying the proper correction term X, according to Equation (1).

The use of the alignment chart is even simpler than this but the graph given here is of value in showing the sign and magnitude of the error involved in the substitution of the arithmetic mean for the log mean for all values of r in the range of the graph. This has not been done before, text books giving the magnitude of the error for a few arbitrarily selected values of r but not the sign.

On page 213 of the second edition of Nelson's "Petroleum Refinery Engineering" (McGraw-Hill Book Co., Inc.) a graphical scheme involving a series of curves is given for the calculation of the log mean temperature difference for heat exchangers. This should be suitable as a third general method.

Correction factor chart: If $A/B = r$, then the log mean $= X(A+B)/2$



Timely Reminder on Welder Maintenance

Arc welders will not be easy to get for the duration. Hence, as has been pointed out by the General Electric Co. through whose courtesy we publish the views below, careful maintenance is going to be necessary to keep present equipment in operation. Periodic inspection of motors and generators will be necessary. About once a week both should be blown out with low pressure compressed air to avoid damage through blowing conducting or abrasive dust into the insulation. About once a year a complete cleaning and overhaul will be desirable. Particular care must be given to lubrication. Ordinarily, grease-packed bearings will contain enough lubricant for a year when shipped from the factory, but sets run in unusually dirty atmospheres, or for exceptionally long periods, should have bearing inspection and lubrication at six-month intervals. Brush and commutator inspection is also essential, while cooling fans must be cleaned thoroughly and the controls lubricated.

Machinery, Materials and Products

CHEM & MET PROCESS EQUIPMENT NEWS

Compact Furnace

LARGE REDUCTION in materials and ground space requirements per unit of through-put is claimed for the Iso-Flow furnace which has been designed for gas and liquid heating in the chemical and petroleum industries by Petro-Chem Development Co., 120 East 41st St., New York, N. Y. This design is said to require less than half the overall steel, 35 percent less headers, 50 percent less alloys, 30 percent less furnace tubes, 50 percent less refractories, 40 percent less foundation, and 75 percent less ground space than is required for conventional box-type furnaces. Furthermore, an independent stack is unnecessary. The furnace is suggested for use in the manufacture of aviation gasoline, toluene, butadiene and other products.

The design consists of an upright cylindrical combustion chamber with the heating elements placed symmetrically around the burners, with each tube equidistant from the flame burst. By controlling the amount of radiant and convection heat to each section of every tube, practically uniform rates of heat transfer can be obtained for each square foot of heating surface, according to the manufacturer. The cylindrical walls are completely covered by the heating elements, thus assuring a low temperature behind the tubes and practically eliminating the need for conventional refractories. Three standard designs are available, including an all-radiant design, a radiant type with convection zone, and a furnace of either of the above-mentioned types combined with an air heater. Furnaces up to 15,000,000 B.t.u. heat absorption per hour are prefabricated and shop assembled. Larger furnaces are prefabricated and shipped in large segmental sections for easy field assembly.

Novel Pump

PUMPING of liquids ranging from low to high viscosities, without requiring priming each time the pump is started, is claimed for the new Jabsco pump, manufactured by Jabsco Pump Co., 8304 Wilshire Boulevard, Beverly Hills, Calif. As is evident from the accompanying illustration, the new pump contains but one moving part, a flexible impeller made of neoprene, mounted on a centrally located shaft. The flexible impeller fits snugly inside the housing, creating a near vacuum as it rotates, and thus drawing in material from the suction side without the need for priming. The impeller is said to permit the handling of a certain amount of solids without clogging or injury, and to be low in friction and operating cost. All parts except the impeller are of bronze, there are no adjustments and the pump has no parts to become noisy when worn.

This pump is suitable for use in low pressure applications and is available in sizes ranging from ¼ to ¾ in., with capacities from 2½ to 22 gal. per minute. The pump may be operated in either direction and mounted at any angle.

Bleach-Making Apparatus

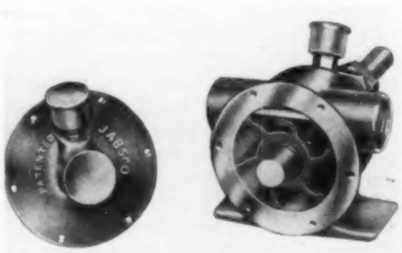
COMPANIES using calcium hypochlorite for bleaching purposes can manufacture their own bleach at 5 percent concentration, containing up to 50 gm. of available chlorine per liter, employing the new Emar bleach-making apparatus manufactured by the Emar Electro-Bleach Equipment Division of Embree Mfg. Co., 10 West Mravlag Place, Elizabeth, N. J. The equipment makes 1 gal. of 5 percent bleach from 1.4 lb. of salt and 0.8 kw.-hr. at a cost of approximately 1¾ cents per gallon. It duplicates on a small scale the equipment ordinarily used in the large scale manufacture of chlorine and caustic soda.

The heart of the unit is the Emar cell which is welded and assembled as a complete portable unit, ready to hang on the insulated bars of the standardized frame. The cells operate at approximately 3 volts, increasing to about 4½ volts with continued operation after several months, when it generally becomes advisable to replace diaphragms and turn the anodes. Diaphragms and anodes are easily replaced. Chlorine and caustic soda are produced and may be used separately, if desired, or automatically combined in an in-built continuous reaction absorber to produce the bleach solution. A variety of capacities are obtainable, ranging from a small machine making 15 gal. of 5 percent bleach per day, to any desired size which may be obtained by multiplying the number of basic units.

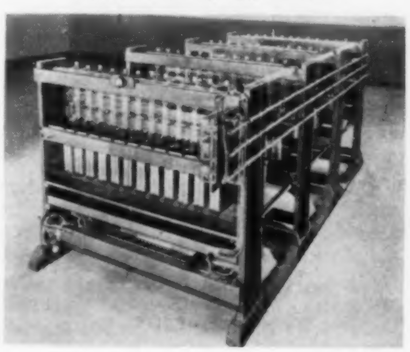
Infra-Red Heat Lamps

DESIGNED in keeping with the limitations imposed by the War Production Board, a complete new line of infra-red heat lamps has been announced by the Birdseye Div. of Wabash Appliance Corp., 335 Carroll St., Brooklyn, N. Y. Six clear types, three ruby types, and four reflector types are included in the line, all of which feature the M-type tungsten filament for uniform heat distribution. In all

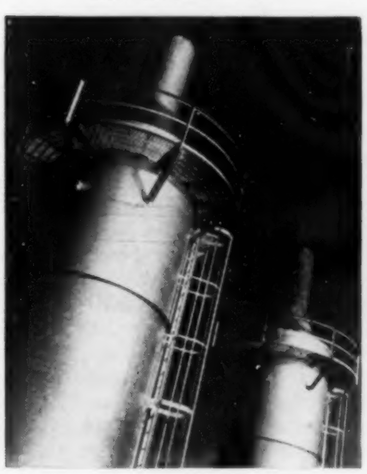
Jabsco neoprene impeller pump



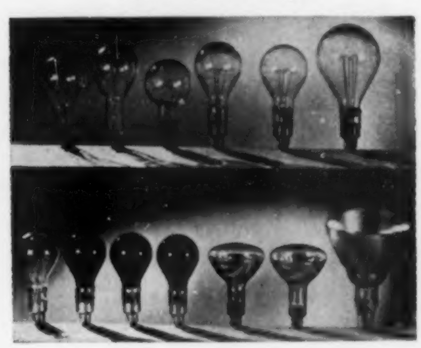
Bleach-making apparatus



New Iso-Flo furnace



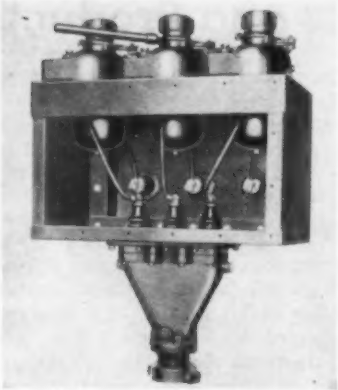
New infra-red lamps



types the bases are reinforced with asbestos-lined mechanical straps to withstand the high temperatures encountered in tunnel installations. Reflector types have built-in reflector linings of pure silver sealed within the bulbs. Average burning life on all types is claimed to be in excess of 6,000 hours. Hundreds of thousands of these new lamps are already stated to be in industrial use, doing a better, faster, cheaper and easier job than the conventional heat-treating methods.

Oil-Fuse Cutout

To ASSURE economical short-circuit protection and switching, General Electric Co., Schenectady, N. Y., has announced a new metal-inclosed assembly of gang-operated oil-fuse cutouts, permitting totally metal-inclosed installations, either single- or three-phase. The new assemblies are said to save installation labor, being factory assembled with flexible insulated cable leads, ready for connection to either single- or multi-conductor cable. The leads enter the individual cutouts above the oil level, thus preventing loss of oil. Switching merely requires throwing a lever through 90 degrees. Fuse carriers can be removed without disturbing the gang-operating mechanism. The new assemblies are said to be particularly well adapted for either indoor or outdoor industrial use for branch circuits, individual transformers or banks, motors, control apparatus, electric-heating, and other equipment. Various rating combinations are available in ranges from 2,500 to 7,500 volts, and up to 300 amp. at some voltages.



Oil-fuse cutout assembly

Fluorescent Light

FLUORESCENT lighting fixtures which employ a new method of ballasting to give positive, instantaneous starting are now being produced by R & W Wiley, Inc., 777 Hertel Ave., Buffalo, N. Y., for use in industrial plant lighting applications. It is claimed that with the new method the lights come on fully at the turn of a switch, just as in the case of incandescent lighting. The conventional starting device is eliminated in the new fixtures. Other features claimed by the manufacturer include positive starting at lower atmospheric temperatures and lower voltages, no radio interference, and satisfactory tube life. The new fixtures are available in types for all applications including continuous and separate units, units for suspended or close-to-ceiling mounting, open reflectors and louvered models.

Fluorescent fixtures in drafting room

Buna S Conveyor Belt

COMPLETION by Hewitt Rubber Corp., Buffalo, N. Y., of an all-synthetic-rubber conveyor belt, believed to be the first of its kind made from Buna S without the addition of natural or reclaimed rubber, has recently been announced. Ever since the introduction of oil-resisting types of synthetic rubber in the United States in 1931, this company has been working in the production of synthetic rubber products. Buna S is a non-oil-resistant synthetic which, as the Government plants swing into mass production in 1943, will gradually replace natural rubber in such articles as conveyor and elevator belting, transmission belting, pneumatic tool and welding hose, fire hose, acid and chemical hose, and many miscellaneous molded articles.

Buna S conveyor belt

Rapid Concrete Cure

AS IS WELL KNOWN, freshly poured concrete must be protected from rapid drying, since water which evaporates from the mixture does not have time to enter into the desired chemical combination. The Truscon Laboratories, Detroit, Mich., has recently announced a new transparent liquid which can be sprayed on newly laid concrete, forming a water-impervious film which is claimed to retain the water to such an extent that some 93 percent still remains seven days after the concrete is laid. This material can be applied immediately, whereas conventional methods of covering and wetting down of fresh concrete generally require waiting several hours until the concrete is hard enough for the application of the curing materials. The new material, Tru-Cure, is claimed to produce concrete which is much harder and stronger than that made by other curing methods. It may be used on both formed and unformed concrete wherever water retention is necessary. It is claimed to provide the equivalent of a 14-day water cure without marring or discoloration of the concrete.

Activated alumina tank breather

Tank Breather

ACTIVATED ALUMINA is the active principle in the new line of Lectrobreathers recently developed by Pittsburgh Lectrodryer Corp., 1026 32d St., Pittsburgh, Pa., for use in preventing the entrance of atmospheric moisture into oil and chemical tanks. These devices are small-sized activated alumina air dyers which are mounted either directly on the tank or piped to it. They are equipped with color indicators for determining when reactivation is needed or when it is complete. Where Lectrobreathers are required for several tanks, standard practice is to use one such device on each tank and a central reactivator for all breathers. However, air leaving these tanks, being thoroughly dried, has a partial reactivating effect which makes possible long periods of use between reactivation. Reactivators are built for electric operation in all sizes, or for steam operation on the two largest sizes.

Three-Way Valve

REDESIGNED to include both larger iron pipe sizes and port sizes, an improved line of three-way magnetic valves has been introduced by General

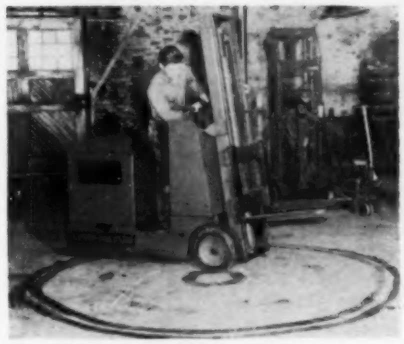
Portable gage comparator

Using Fleetweld 11 electrode

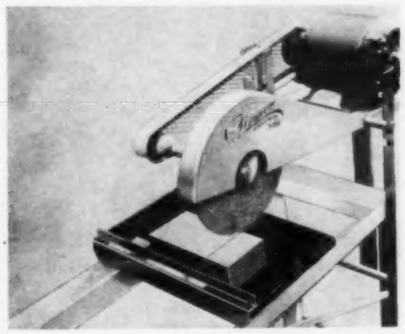
Controls Co., 801 Allen Ave., Glendale, Cal. These valves are capable of handling oil, water, air, gas, steam, refrigerants and similar fluids which are not corrosive to the valve material, up to 400 deg. F., in sizes to 1 in. and port sizes to 15/32 in. The valves are suitable both for applications where fluids are to be distributed to two points from a common source; or for the control of fluids to pistons and diaphragm operators on valves, doors, and gates. The valves are of the single magnetic type so that the valve cannot assume an intermediate position, that is, when the common port is connected to Port No. 1, Port No. 2 is closed. When Port No. 2 is open to the flow, Port No. 1 is closed. The valve construction is such that either connection can be made when the current is on, the other when the current is off.

Portable Gage Tester

A PORTABLE pressure gage comparator designed for the quick and accurate testing of pressure gages in place, without breaking line connections, has been introduced by the Grove Regulator Co., Oakland, Cal. The comparator consists of a carrying case equipped with three precision laboratory test gages, accurate to within ¼ of 1 percent of full scale, and designed for checking various ranges of pressure from 0 to 1,000 lb. The necessary testing pressure is applied from built-in high-capacity air cylinders which can be charged or recharged as often



Tilting fork truck



Improved masonry saw

as required with any clean dry gas, or with air or oxygen. Close pressure control is made possible by three Grove Pressure Loaders mounted below the test gages. These devices serve as accurate pressure reducing valves with built-in automatic relief.

Masonry Saw

A NEW power-operated saw for the cutting of a variety of masonry units including firebrick, acidbrick, glazed tile and a variety of high temperature refractories has been introduced by the Clipper Mfg. Co., St. Louis, Mo. The cutting element in this new unit is a thin abrasive disk which is operated at high speed by a 1- or 1½-hp. motor. The unit consists of a metal framework carrying a movable table on which the brick to be cut is supported for movement under the cutting disk. By means of a foot pedal, the disk is lowered to make the cut. The cutting head is counterbalanced by the weight of the motor. This cutting method is claimed to be six times faster than other methods employing equal power. It is being employed by gas plants, cement, lime and chemical manufacturers and glass plants. Several models are available, depending on the types of cutting required.

High Speed Electrode

FLEETWELD 11 is the name of a new arc welding electrode recently introduced by the Lincoln Electric Co., Cleveland, Ohio, expressly for use with this company's recently announced "Fleet-Fillet" technique of arc welding. The new electrode has been designed to obtain maximum benefit in speed of welding from the new technique. It is claimed that the new electrode is not only fast flowing but gives deeper penetration of metal into the root of the joint. It is of the shielded arc type and heavily coated to exclude oxides and nitrides from the weld to assure high quality. In a demonstration the new electrode is said to have welded a joint in 35 seconds which required 1 min. and 17 sec. to weld with conventional electrodes and ordinary procedure. About 100 percent faster fillet welding is possible, with less operator fatigue and lower welding costs. The new electrode gives the same strength as a weld made by ordinary methods but requires less metal, in a typical instance needing 0.26 lb. of electrode per foot of weld, as compared with 0.37 lb. by ordinary procedure. Welding cost is claimed to be reduced by one-third to one-half as compared with usual procedure.

Tilting Fork Truck

AFTER a long period of experiment and design, Lewis-Shepard Co., 123 Walnut St., Watertown, Mass., has placed in production a line of medium capacity (3,000 lb.) industrial lift trucks of the tilting fork type, available in both telescopic and non-telescopic types. These new trucks are made in both gas- and electric-powered models. They are of compact design with a low center of gravity, capable of pivoting in practically their own length as shown in the accompanying illustration. They are of the center control type, with a simplified system of controls permitting a new operator to run them smoothly almost immediately, according to the manufacturer. In the electric model, traction speed ranges from 5 to 6 m.p.h., with a lift speed of 18 ft. per min. under full load and a lowering speed of 40 ft. per minute. Tilt and hoist are both operated by means of hydraulic power. In the gas-powered model, the traction speed is 7.5 m.p.h. and the lifting speed 30 ft. per min. under full load, with other specifications as already described.

Equipment Briefs

WHERE complete fire resistance is required, a new flame-proof fluorescent lighting fixture of molded asbestos is available. Manufactured by Century Lighting, Inc., 419 West 55th St., New York, N. Y., the fixture has been approved by Underwriters' Laboratories as an acceptable substitute for steel lighting fixtures.

DETERMINATION of thickness of all types of plastics and similar compressible materials is possible with an extremely high degree of accuracy through use of the Model M-25 Car-

son electronic micrometer, according to the manufacturer, Instrument Specialties Co., 27 Peckman St., Little Falls, N. J. This instrument is specifically designed for uniform thickness testing, is portable and eliminates the human element in micrometer reading. Measurements accurate to 0.0001 in. can be made, employing an electronic circuit which gives positive indication of the setting point, independent of the "feel" on the dial. The thickness is read exactly as with a hand micrometer. The instrument operates from any 110-volt, 60-cycle circuit.

For use either in emergency water supply, or in emergency fire fighting, Technicraft Engineering Co., 5610 South Soto St., Los Angeles, Calif., has developed the Sterozone Hydrovan, a portable pumping and water sterilizing unit employing ozone as the purifying element. The unit is mounted on a two-wheel trailer and is equipped with 50 ft. of 4½-in. intake hose and 400 ft. of 2½-in. fire-fighting hose. A gasoline engine drives an electric generator and fire pump. Water can either be purified at the rate of 20 gal. per min. employing the Sterozone purification unit, or pumped through the fire hose at the rate of 200 gal. per min., employing the pump, for fighting a fire.

A simple device for the trimming of blueprints and drawings is available in the Edi trimming machine, manufactured by Edi Trimming Machines, 609 West 115th St., New York, N. Y. The cutting element is a razor blade mounted in a holder moving on a track which can be folded down over the drawing. Machines are available in four sizes, having cutting sizes ranging from 25 to 55 in. It is claimed that clean cuts, which are entirely rectilinear and square, can always be obtained.

A new coupling-head thermostatic switch or Thermoswitch has recently been announced by Fenwal, Inc., Ashland, Mass. The thermostatic element is inclosed in a brass shell, to one end of which is attached the coupling head. The brass shell can be made tight in any liquid or gas system by means of the ½-in. standard thread on the head, while by means of a second threaded portion, various types of condulets such as waterproof or explosionproof fittings can be attached for inclosure of the leads. The switch is available for operating temperatures from —50 to +400 deg. F., for current ratings of 10 and 25 amp.

Kobbe Laboratories, Inc., 114 East 32d St., New York, N. Y., has announced the availability of a new type of sulphur taper for the detection of ammonia leaks and for general fumigating and deodorizing applications. These tapers are also stated to be useful in the igniting of sulphur in sulphur burners.

Transformer Cooling System

Vitally needed increases in power transformer capacities can now be obtained quickly, according to Allis-Chalmers Mfg. Co., Milwaukee, Wis., through use of a new system of forced-circulation oil cooling. This system is said to save 25 percent in critical war materials on new transformers and to step up the capacity of transformers already in service by from 20 to 60 percent.

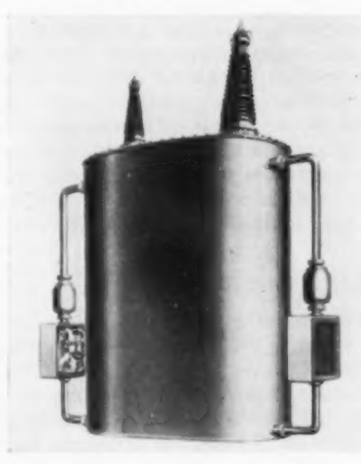
The new cooling unit, called the "Electro-Cooler," is a compact factory-assembled unit consisting of a radiator-type cooler and a special pump with inclosed motor. The unit is connected by piping to the standard radiator valves at the side of the transformer. The pump requires no stuffing box, the motor is self-cooled and self-lubricated. These units are employed in multiple, the number depending on the size of the transformer, thus giving greater reliability than could be expected from a single unit.

In the case of transformers equipped with conventional type radiator valves, it is said that installation can be made in three to four hours without removing the oil from the transformer. Use of the new unit avoids the necessity of adding new transformer units and is thus believed by the manufacturer to be a much needed solution to the wartime problem of over-loaded transformer banks.

Water Testing Equipment

Testing of water for the determination of hardness, alkalinity, chlorides, phosphates and sulphites, when any two, three or four of these tests are required, is possible with the new A Series test sets recently made available by W. H. & L. D. Betz, Gillingham and Worth Sts., Frankford, Philadelphia, Pa. The sets include the necessary chemicals and apparatus, contained in a special cabinet designed for use on a table or mounted on a wall. A portion of the opened cabinet door forms a convenient acid-resistant laboratory work table and a fluorescent light provides correct illumination for the tests.

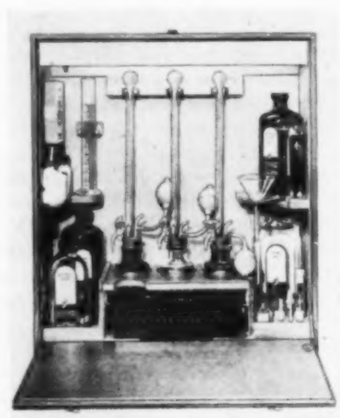
"Electro-Cooler" for transformers



Ionization Gage Meter

Limited numbers of a new portable ionization gage meter designated as Type HG-200, designed for use in conjunction with the company's ionization gage, Type VG-1, are expected soon to be available from Distillation Products, Inc., Rochester, N. Y. The combination of meter and gage provides a method for measuring pressures in the low range from 10^{-3} to 10^{-8} mm. of mercury. The meter circuit features a stabilized amplifier in a balanced vacuum tube of voltmeter design with negative feedback, and an integral amplifier recalibration for elimination of amplifier variation. Gas tube voltage regulation and automatic grid current control eliminate other performance variations. This circuit is said already to have proved itself reliable and rugged on many production systems. Furthermore, it is simply designed and can be handled by non-technical employees. The meter comes complete with all necessary cords and plugs and an ionization tube ready to seal on to any Pyrex glass system. The meter operates from any 110-115 volt, 60-cycle line.

Water test set



Ionization gage meter

A Modern Distillery

Through research and development, the Seagram distillery is emerging from an antiquated, inefficient, batch distillery to a modern, continuous processing plant.

Whole grains arrive in freight cars. They are unloaded, graded, cleaned, and stored in whole grain bins. They pass from the bins through a magnetic separator and are reduced to a meal in a roller mill. The meal is conveyed to intermediate storage bins and as required is weighed and mixed with water to form a slurry. This slurry is heated instantaneously in the presence of mineral acid in a steam jet under a pressure of 165 lb. per sq. in. The starch is completely gelatinized and converted to fermentable sugars. This material leaves the cooker, is neutralized with a sterilized lime slurry, and is "blown down" in a flash chamber where the pressure is reduced to atmospheric pressure. The mash is then pumped through a cooler until it reaches the fermenting temperature.

Yeast that has been prepared by a continuous process, together with the cooled mash and various yeast growth supplements, goes to the fermenting vessel. A fast, continuous fermentation has been developed and after an initial growth period of from 20-24 hr. new material is constantly fed into the top of the fermenter. The fermented beer, containing 6-7 percent alcohol, is pumped to the beer well. It is sent to the beer column where the volatile material is removed from the fermented mash. Vapors from this column are fed to an aldehyde column where the light boiling aldehydes, esters, ketones and acids are removed.

In the third distillation column there is a mixture of ethyl alcohol, water, and fusel oil. The alcohol is carried to the top of this column by distillation and is concentrated to 190 proof. The fusel oil and water are drawn to the oil column where the oil is purified and removed. The mash (stillage) that comes from the beer still contains everything in the original grain except the starch and in addition it contains yeast that was added for the fermentation. The spent mash is 95 percent moisture, 5 percent solids. The latter are removed. This press cake contains 28 percent protein and is a good dairy cattle feed.

In the meantime the liquid that passed through the screens and was squeezed from the press cake is evaporated in a five-body, quadruple-effect, long-tube evaporator and on a rotary drum-type dryer. The solid material is sold as high vitamin content feed and may be used as a substitute for skim milk.

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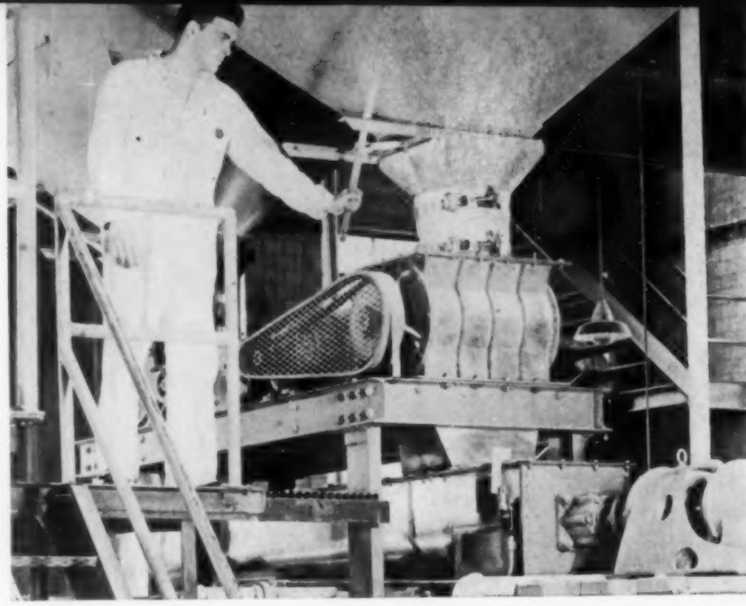
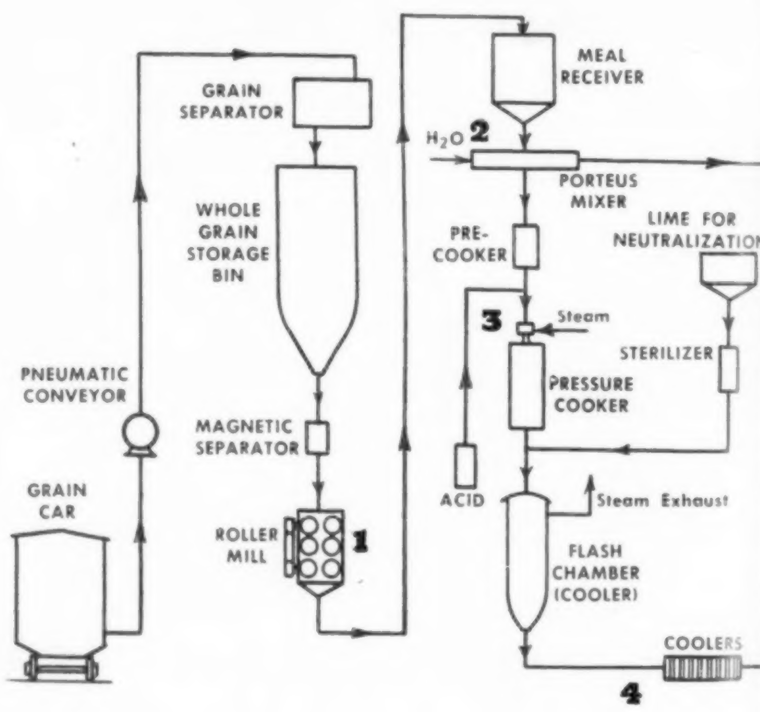
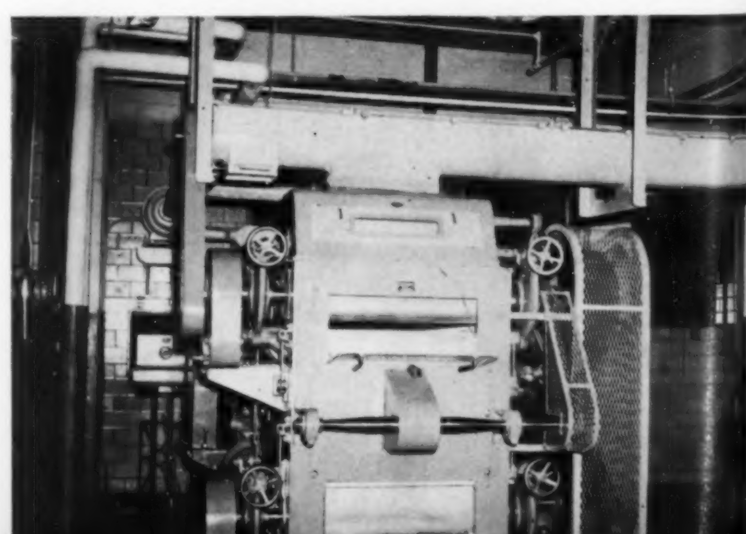


2 Meal is conveyed from the bottom of the mill to storage bins and as required is weighed continuously and mixed with water to form a slurry

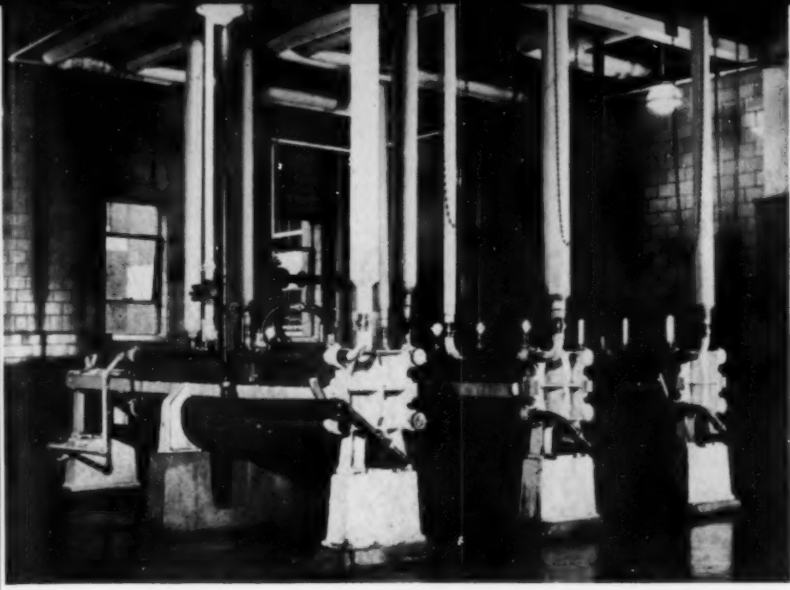


1 Whole grains, corn, rye and wheat, are conveyed from temporary storage bins to this three roller mill where they are ground to a meal

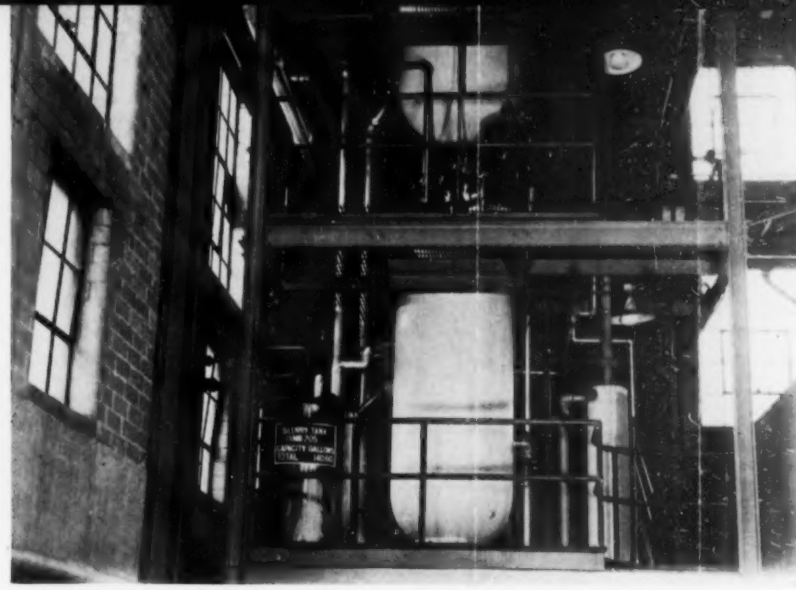


4 Aft…
through…

3 The…
pumped…

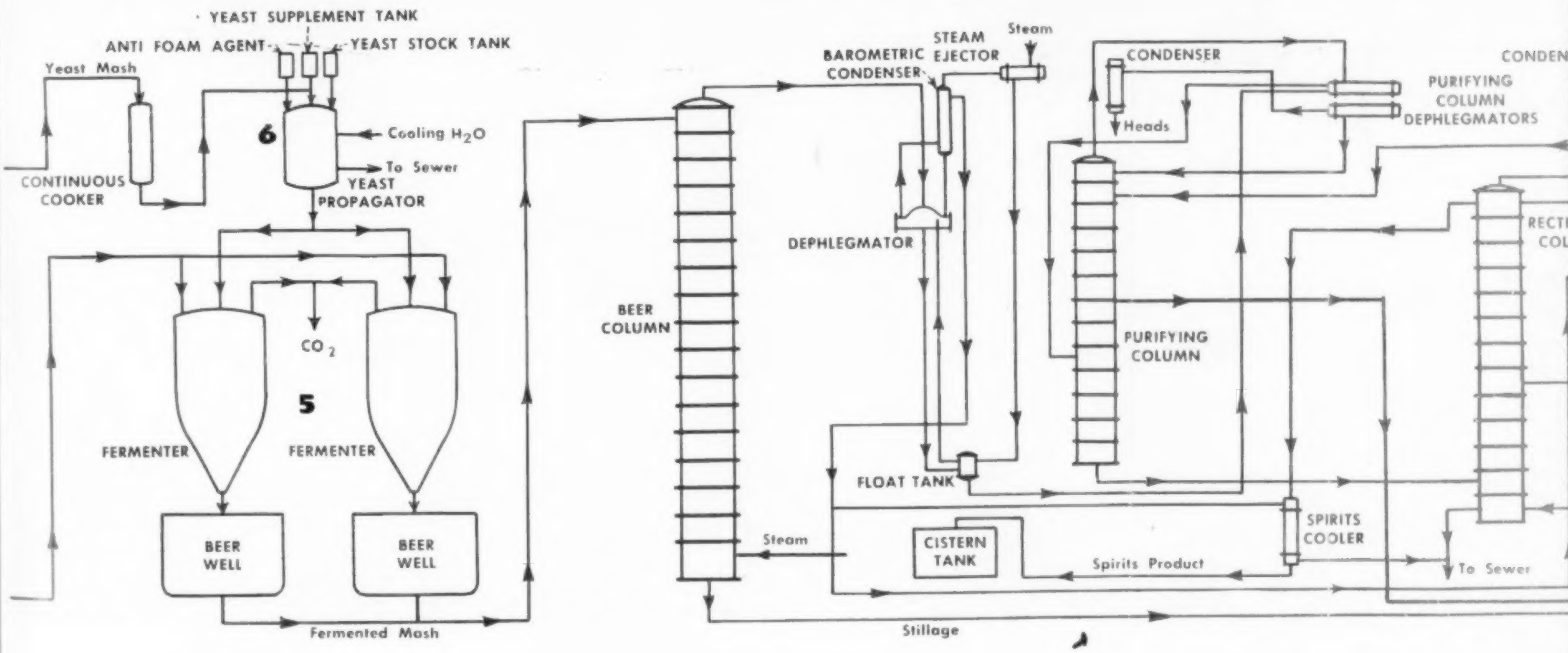


4 After cooking, mash is neutralized, pressure reduced and then pumped through Para-Flow cooler until it reaches fermenting temperature



6 Yeast that has been prepared by a continuous process for the production of pure culture distillers' yeast, is added to the fermenter

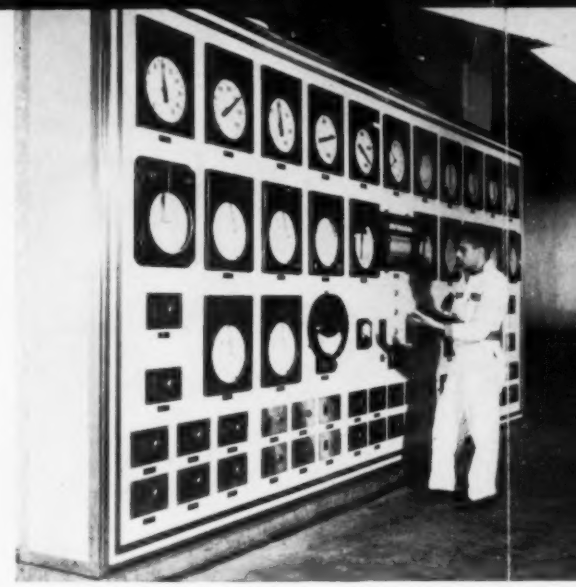
8 De-alc… over these …



3 The mash slurry with conversion acid is pumped through this jet steam cooker

5 Mash slurry is pumped into one of the fermenters. A fast continuous fermentation has been developed and after an initial growth period new mash is constantly fed into the top of the fermenter

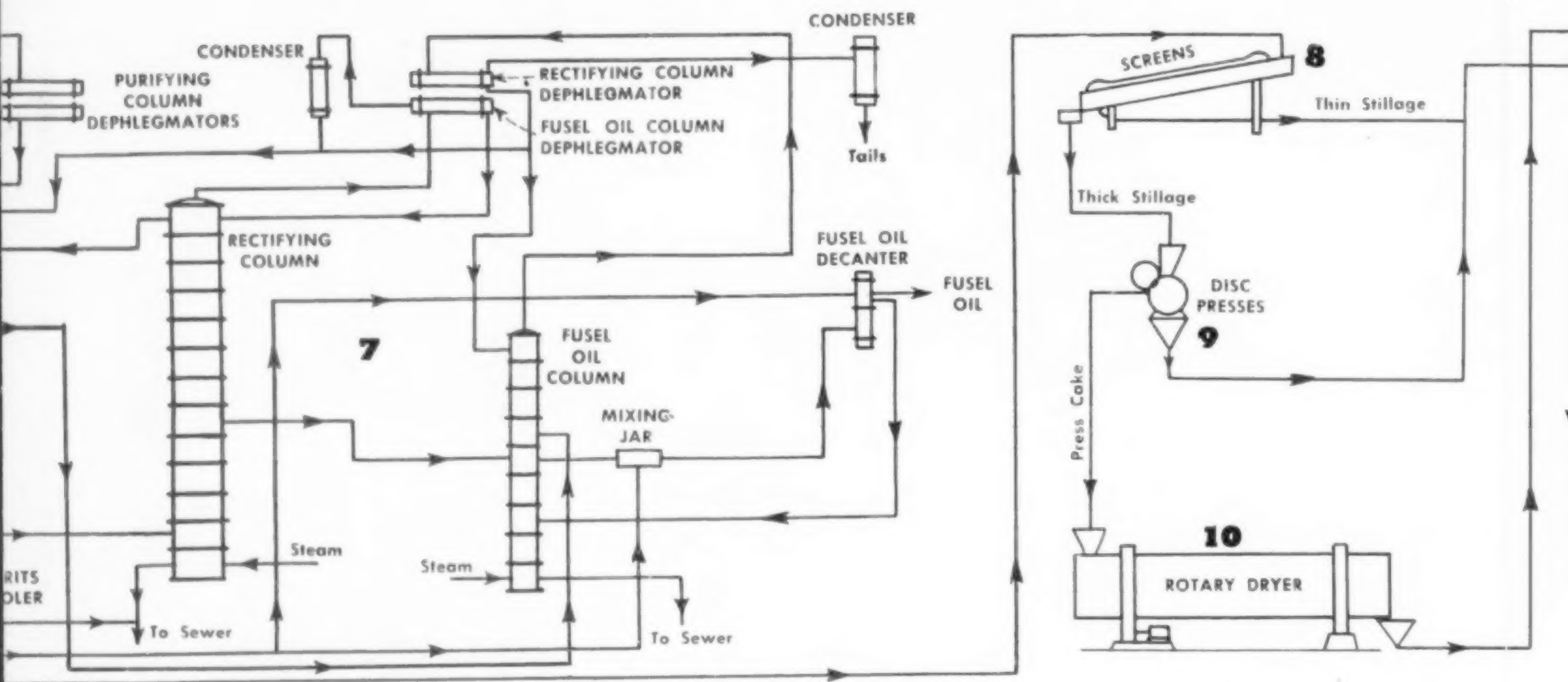
7 Control … from a 6-7 …



duction

8 De-alcoholized mash (stillage) that comes from the beer stills is passed over these gyrating screens to separate dissolved from undissolved solids

10 Evaporators are controlled from a central control ground, a rotary dryer used to dry insoluble press cak



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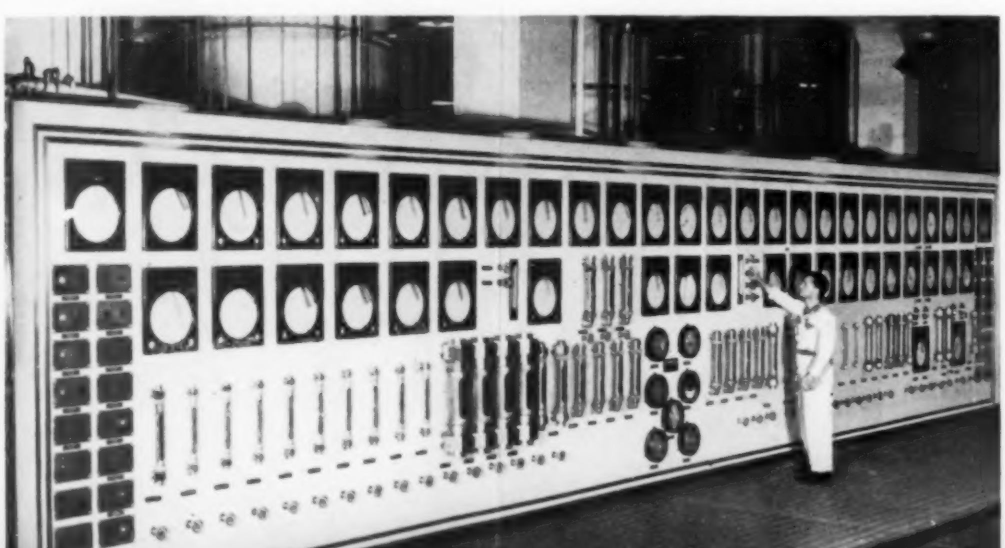
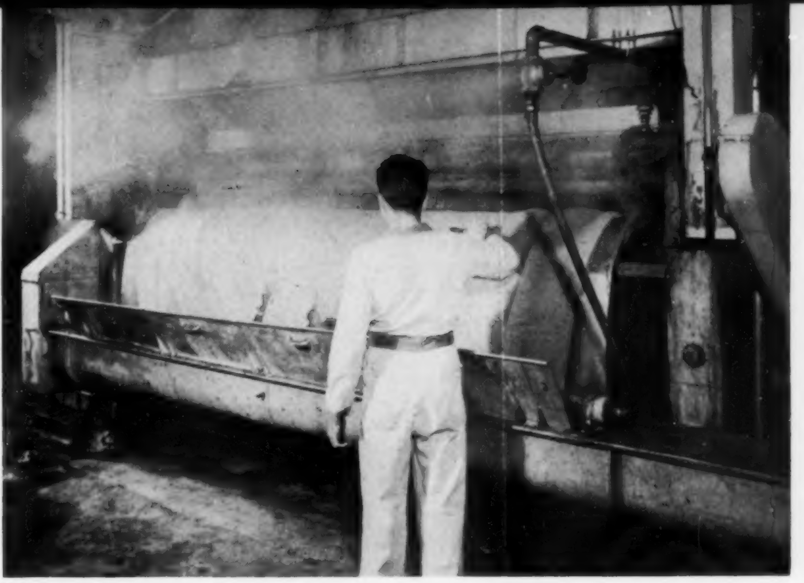
7 Control panel to continuous alcohol still is pictured below. The still concentrates alcohol from a 6-7 percent mash solution to one containing 95 percent industrial alcohol

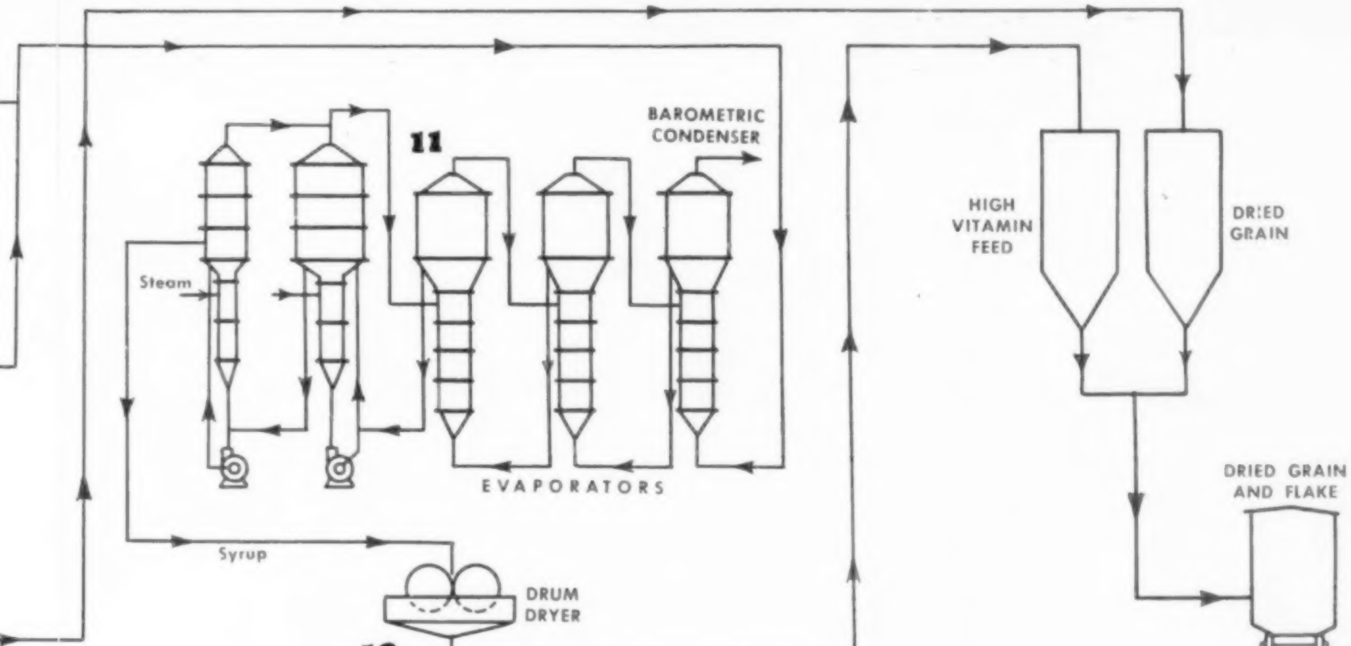
9 Solids fall down a hopper an press pictured below. This press c





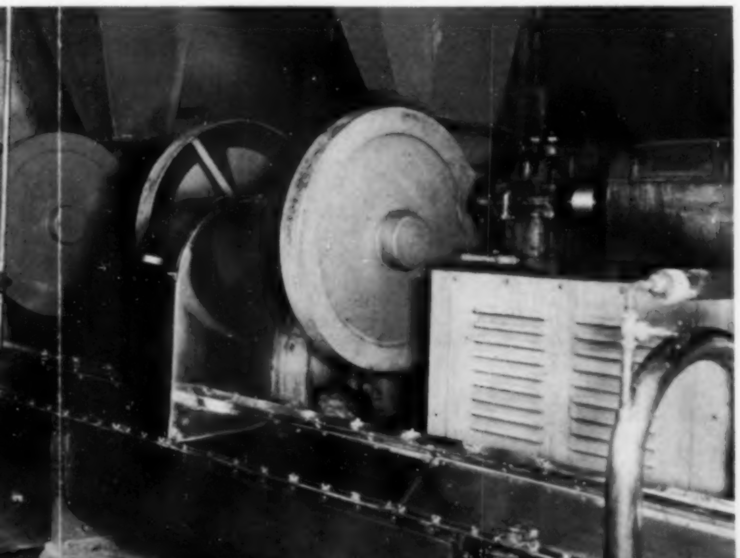
...ntral control panel. In the back-
...le press cake is shown

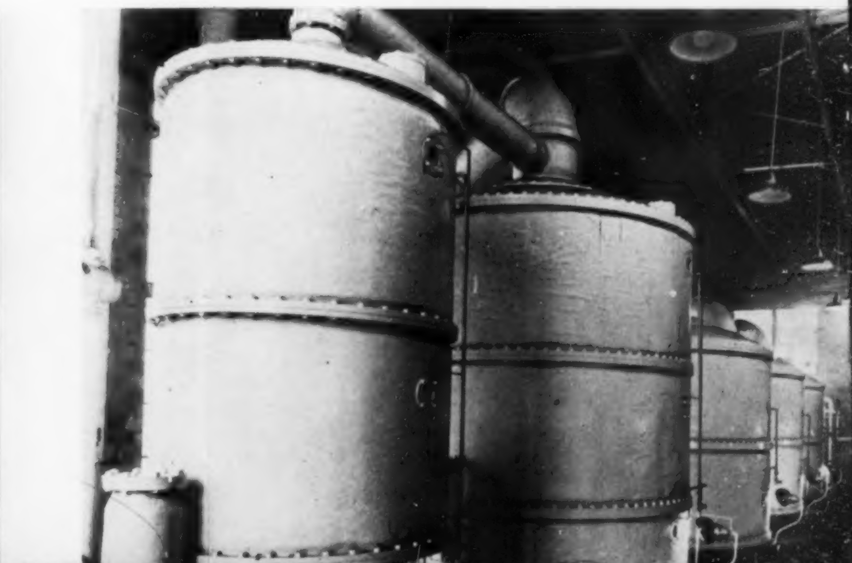
12 Syrup containing 30 percent solids serves as feed for a rotary drum-type dryer which reduces moisture. The cake comes off as a sheet

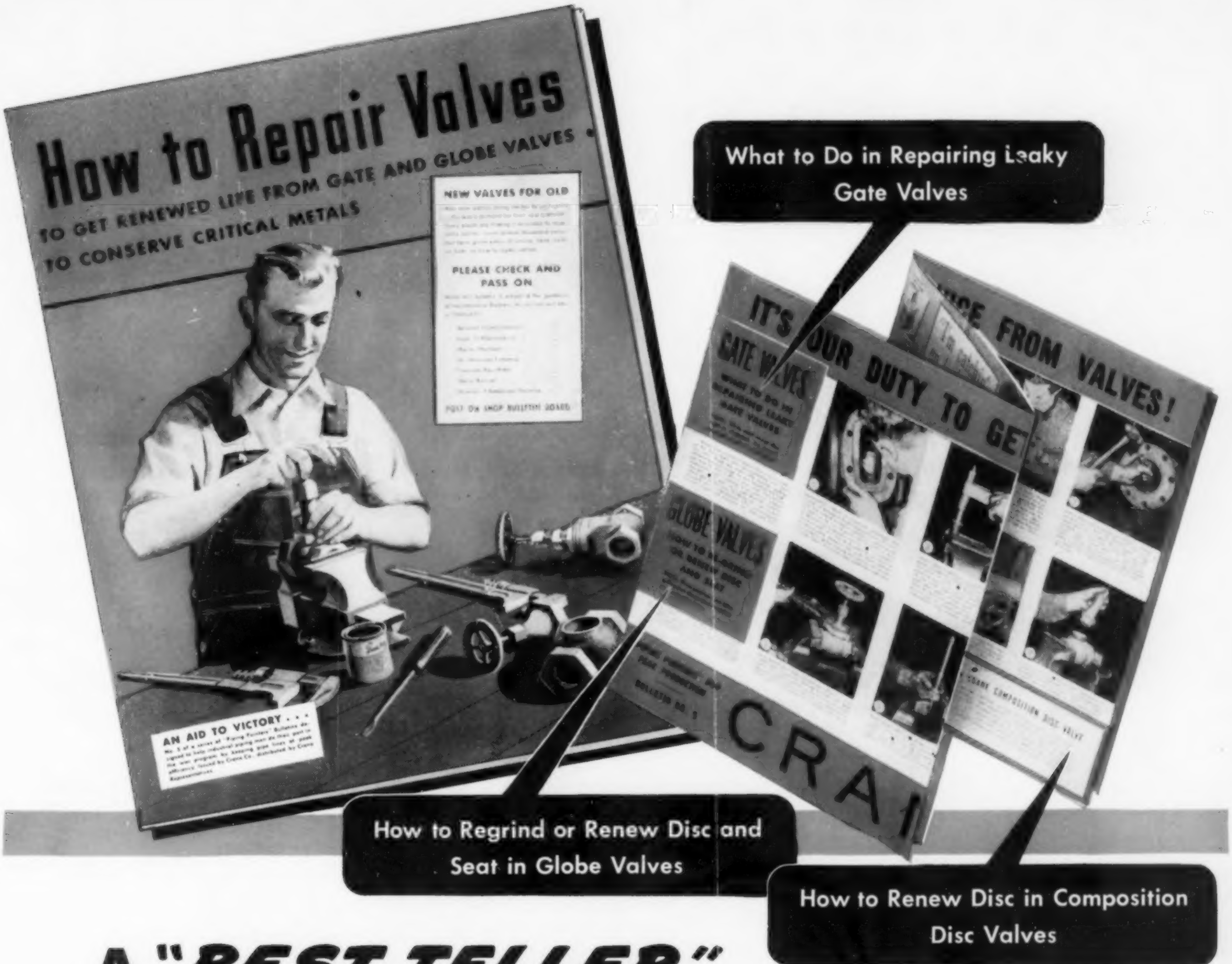


...a hopper and are given a squeeze between convex screens in a ... This press cake serves as feed for a rotary steam tube dryer

11 These evaporators are used to concentrate the soluble material from 3 percent solids to 30 percent solids







A "*BEST TELLER*" FOR PIPING MEN

Look at the timely subjects covered in "Piping Pointers" Bulletin No. 5. What is more important to piping men—NOW—than knowing how to repair valves for better and longer service—to keep war production lines flowing—to conserve metals! We don't know of any other current source of such vital information.

"Piping Pointers" are designed to help you train men for the big maintenance job that faces industry at war. Their content is fully accurate and practical—it's based on Crane Co.'s vast experience as America's leading producer of valves and fittings. Even veteran workers use "Piping Pointers" to keep up-to-date.

FREE TO ANY PLANT

In "Piping Pointers," Crane shares its basic information with all industries producing for Victory. This service is *absolutely free,* yet countless plants have testified to its inestimable value in maintenance shops and employee training schools. If you're not using "Piping Pointers" now, let your Crane Representative arrange for your supply.

Five "Piping Pointers" Bulletins have been published to date. To meet the demand, extra supplies of all editions have been printed. Get the entire series now—when you need them most. *First come first served.*

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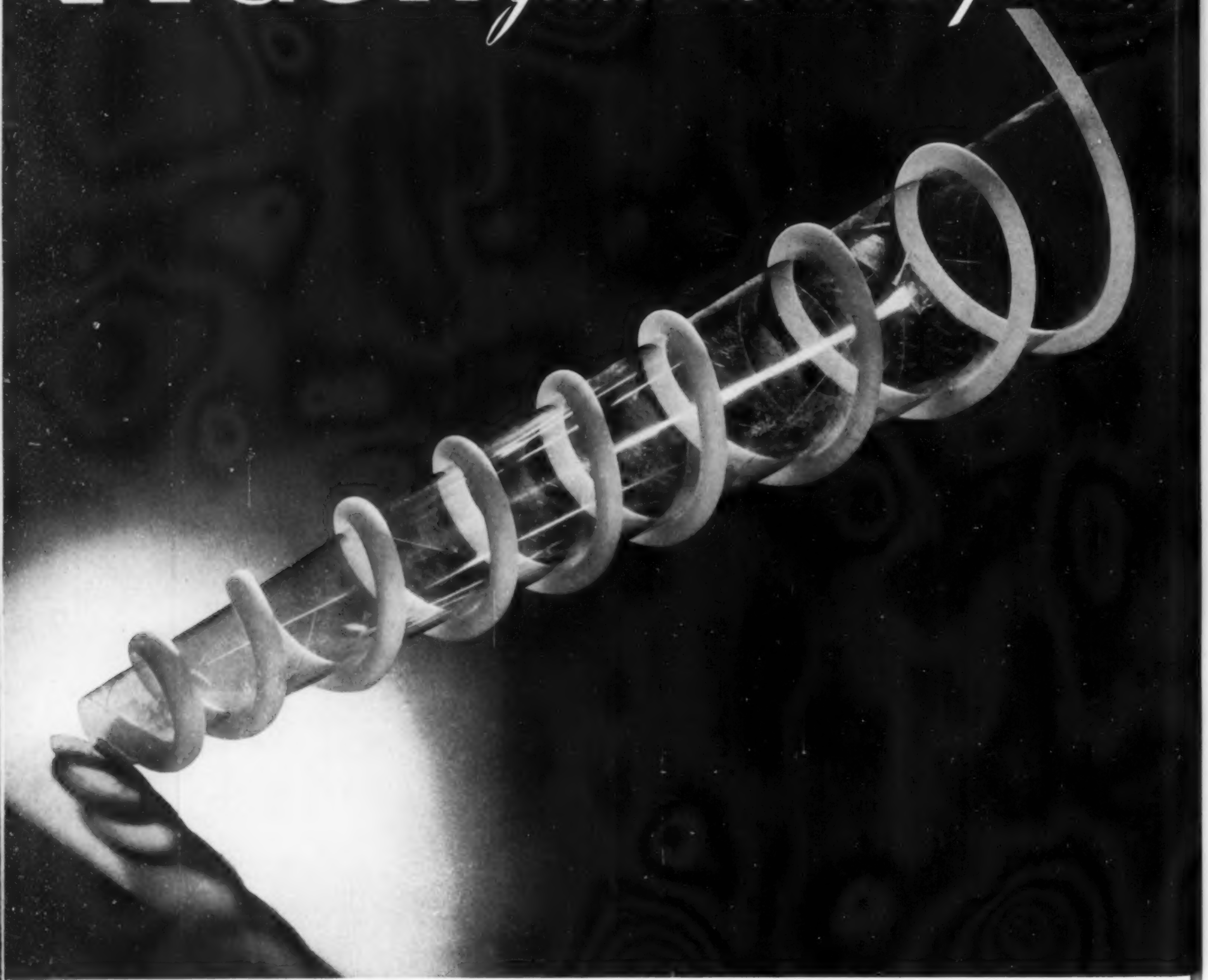

EXTREMELY tough, highly resistant to abrasion, immune to the action of most corrosives, Tygon tubing is finding an ever growing number of uses in industry . . . not as a substitute . . . but as a better piping medium than metals or rubber for gas, air and liquids.

Tygon tubing is flexible and elastic. In comparison tests on vibrating automatic machines where tubing undergoes continuous twisting, flexing and pulling, Tygon has shown a "flex" life ten to twelve times that of rubber. With multiple braid reinforcement it can be made to withstand high pressure; it retains its flexing ability under freezing temperatures, and will withstand heat up to 175 degrees F.

Tygon tubing is unaffected by oil, gasoline, salt or fresh water; it is inert to the action of almost all corrosives; it is non-toxic; and it is not subject to chemical aging.

Tygon tubing is available in a wide range of sizes, in varying wall thicknesses, together with Tygon molded couplings. It can be made transparent, translucent or opaque; and in a wide color range for ready identification purposes.

Tygon tubing is being used for recording devices, siphons, sight glasses, etc., on process equipment; in hospitals and laboratories; in drug manufacturing; in breweries and food processing plants. It is used for such purposes as insulating jackets for electric wiring, and for gasketing. In fact, for any purpose where a flexible, sturdy, highly corrosion-resistant tubing is required.

Tygon, one of industry's most versatile synthetics, is also available in rigid or flexible, transparent, translucent or opaque sheets; as a liquid for use as a paint or impregnation of porous materials; and in formulations for casting, extruding or molding.

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CHEM & MET NEWS

ANACONDA COPPER WILL OPERATE BASIC MAGNESIUM PLANT

J. R. Hobbins, president of Anaconda Mining Copper Co. and Frederick Laist vice-president in charge of metallurgical operations, have been selected as president and vice-president respectively of Basic Magnesium, Inc. These two men together with Cornelius F. Kelley, chairman of the board of Anaconda will serve as directors of Basic Magnesium. This action followed the announcement of Secretary of Commerce, Jesse Jones that Anaconda had acquired the 52½ percent stock interest in Basic Magnesium formerly held by Howard P. Eells, Jr., and associates of Cleveland. The purchase price was reported as $75,000. Secretary Jones also announced that the Defense Plant Corp. had bought the ore lands of Basic Magnesium situated near Gabbs, Nev. for $450,000.

Officials of Anaconda stated that their company had been invited by the Government and by British and American interests involved to take over the management of the magnesium company and to take charge of the operation of the project. The magnesium plant is located at Las Vegas, Nev. and the first unit went into production on Aug. 31. It is estimated that the entire plant will be completed by April 15, 1943.

E. C. P. D. ADDS MANY CURRICULA TO ACCREDITED LIST

Notre Dame and the University of Toledo have been added to the list of United States colleges whose engineering courses have been accredited by Engineers' Council for Professional Development, joint agency of eight engineering societies in the United States and Canada. At Notre Dame, curricula in aeronautical, civil, electrical, mechanical, and metallurgical engineering have been accredited; and at the Toledo school, the course in general engineering. Additional curricula have also been inspected and accredited by Council at twelve other colleges: chemical engineering at Bucknell; mechanical engineering at Catholic University of America; chemical engineering at Cooper Union Night School of Engineering; chemical engineering at the University of Florida; ceramic engineering at Georgia Tech.; geological engineering at Idaho; chemical engineering at Maryland; chemical engineering at Northeastern; chemical engineering at Oregon State; aeronautical engineering at Texas A. & M.; civil, electrical, and mechanical engineering at Southern California; and chemical engineering at Worcester Tech.

At the tenth annual meeting of the Council, just concluded in New York City, R. E. Doherty, president of Carnegie Institute of Technology, was reelected chairman. Other officers elected are S. D. Kirkpatrick, editor of "*Chemical and Metallurgical Engineering*", vice-chairman; A. B. Parsons, secretary of the American Institute of Mining and Metallurgical Engineers, secretary; S. L. Tyler, executive secretary of the American Institute of Chemical Engineers, assistant secretary.

Committee chairmen, representing the Council's four fields of work, were named as follows: Committee on Student Selection and Guidance—A. R. Cullimore, president of Newark College of Engineering; Committee on Engineering Schools—D. B. Prentice, president of Rose Polytechnic Institute; Committee on Professional Training—Everett S. Lee, engineer, general engineering laboratory, General Electric Co.; and Committee on Professional Recognition—Charles F. Scott, of New Haven.

DAVIS WILL HEAD OFFICE OF TECHNICAL DEVELOPMENT

Dr. Harvey N. Davis, president of Stevens Institute of Technology, has been appointed director of the new Office of Production Research and Development in the War Production Board. This follows a report and recommendations of a survey committee of scientists and engineers working under the chairmanship of Dr. Webster N. Jones of Carnegie Institute of Technology. (See *Chem. & Met.*, Oct. 1942, p. 123)

Dr. Harvey N. Davis

OPRD Director Davis is a mechanical engineer and past president of the American Society of Mechanical Engineers. Prior to becoming president of Stevens in 1928, he had served as development engineer and consultant in the turbine department of the General Electric Co., (1917-18), as an aeronautical engineer for the U. S. Air Service, (1918-22), consulting engineer for the U. S. Bureau of Mines, (1921-25), for the Franklin Railway Supply Co., (1920-7), and the Air Reduction Co., (1922-25). He has been a member of the Board of Visitors of the U. S. Naval Academy since 1939.

SEAGRAM BUILDING PILOT PLANT FOR BUTADIENE

Authorization to build a pilot plant for making butadiene from grain by first fermenting the grain to produce butanediol has been received from the Rubber Reserve Co., by Joseph E. Seagram & Sons, Inc., and work on the plant in Louisville already has begun.

Seagram scientists believe they have made significant discoveries about an economical and practical method for producing butadiene from surplus grain. Preliminary estimates indicate, they say, that a commercial sized plant—capable of producing 20,000 tons of butadiene a year— could be built in from six to eight months after materials were available, and that the butadiene could be made from between 15c and 20c a pound.

The pilot plant that has been authorized will be capable of handling 250 bushels of grain a day. Initial operation of parts of the process is expected by Dec. 15; the plant will be entirely completed by Jan. 15, 1943.

PAINT AND CHEMICAL DIVISION AIDS JEWISH CHARITIES

As part of its commemoration of the 25th anniversary of the New York Federation of Jewish Charities, the Paint and Chemical Division of the New York and Brooklyn Federations will single out four leading members for special tribute. The men are David Ansbacher; A. C. Horn, A. C. Horn Co.; Lothair Kohnstamm, H. Kohnstamm and Co.; and Dr. Maximilian Toch, Toch Bros. In tribute to their years of work an industry-wide dinner will be held on Dec. 3 at the Commodore Hotel, New York. Heading a large committee for the Paint and Chemical Division drive are A. M. Kahn, Consolidated Products Co., chairman; Rudolf G. Sonneborn, L. Sonneborn Sons, Inc., co-chairman; Harry R. Hillman, Eagle Paint & Varnish Works, treasurer; and L. Francis Case, Central Paint and Varnish Works, secretary.

CHEMICAL BRANCH WPB IN NEW OFFICES

For the third time within a year, the offices of the Chemical Branch of the War Production Board have been moved. The new location, where they will be found for the next few months at least, is the Municipal Building at 300 Indiana Avenue, Washington.

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

For the time being, the manpower problem is to be handled without benefit of specific legislation to mobilize and allocate workers. This is the President's decision. It coincides with that of the leaders of the major labor organizations, and it came in the face of War Manpower Commission Chairman McNutt's call for quick legislation. WMC will be given more White House authority, however, to carry on and to make its determinations stick. At the end of October, a new executive order defining the sphere of WMC's domain and limiting the duplicating dabbling of other agencies dealing with manpower was being prepared.

A good share of official Washington feels that the decision not to press for manpower allocation legislation this year represents only a delay, not an abandonment. There are few left who feel that the problem can be handled without an additional grant of authority—but apparently the plan is to let manpower go through the same evolution as materials, from voluntary priorities through mandatory priorities to allocations.

Keynoting the forthcoming struggle to master the manpower problem is President Roosevelt's warning that the nation must learn to ration its workers just as it is learning to ration materials. The President's remark was bolstered in mid-month by the most complete disclosure yet made by the military regarding its own plans for building a fighting force.

The figures used by General Marshall in committee hearings which led to the stampede (interrupted by politics in the Senate) to muster the 18- and 19-year-olds weren't as big as some which had figured prominently in the earlier discussion. But in their overall significance they appeared to bear out what was being anticipated in informed quarters. General Marshall said the Army expects to have 7,500,000 men in uniform by the end of 1943; this means, counting in the Navy, Marines and Coast Guard, roughly 10,000,000 men in military service by that time. To accomplish this requires continuance of the pace of induction and enlistment which has been in progress for the last month or more—fulfillment of the goal means virtual doubling the military force in 14 months, while in the same period several million more workers must be steered into war plants if production schedules are to be maintained.

Controlled Materials Plan

As originally outlined in skeleton form on Nov. 2, WPB's new plan for tightening control over the flow of critical materials into war production apparently makes little basic change in the procedures by which manufacturers obtain their raw materials for operations.

The plan, labelled the Controlled Materials Plan, in essence is an attempt to institute a "vertical" allocations procedure for the "horizontal" procedure of the Production Requirements Plan but in chemical, as in other industries not specializing in munitions and weapons of war, CMP is a combination of both vertical and horizontal. The plan works this way. Prime contractors draw up, quarterly, bills of materials for submission to the appropriate one of seven Claimant Agencies—Army, Navy, Maritime Commission, Lend-Lease, Board of Economic Warfare, Aircraft Scheduling Unit, and Civilian Supply. These seven agencies take their wants to WPB's Requirements Committee which trims them to fit the available supply of material, then allocates to each agency a share of the total. The Claimant Agencies, in turn, divide up their kitties among their prime contractors who divide up with their suppliers all the way down the line.

In the case of most non-direct war end products—virtually everything but planes, tanks, ships, etc.—the "Prime Contractor" under CMP will be the appropriate industry branch in WPB, for the chemicals Branch under E. W. Reid. These branches will make their requests for materials to Civilian Supply which will, after getting its allotment from the Requirements Committee, allot its share among the various non-war industries. Division of the Chemical Branch's allocation very likely will continue to be made under procedure such as P-89 now in effect.

CMP will be put into effect piecemeal as rapidly as the switchover can be made. It will operate in a limited way for the second quarter of 1943 and will become mandatory on July 1, 1943. At first only steel, copper and aluminum will be "controlled materials" on the theory that industrial operations limited in amounts of these materials cannot get far out of line with other materials.

Chemical Industry Essential

A major portion of the chemical industry was formally classified in October by the War Manpower Commission and Selective Service as an activity "essential to the support of the war effort." The designation, covered by Selective Service Occupational Bulletin No. 24 to all draft boards, is important as a guide to local boards in determining the proper men for occupational deferment until replacements can be trained. The classification is important, also, because it automatically shifts all employes, with dependents, in plants covered by the definition to 3-B listing, subject to call after those catalogued 3-A because of working in industries not defined as essential to, or in support of, the war effort.

Accompanying the industry classification ruling from Selective Service is a list of 52 occupations common in the industry for which local boards are directed to give special consideration in cases of occupational deferment requests. Deferment, however, it must be emphasized, remains on an individual case basis and board action hinges upon the employe's skill in the listed job and the employer's ability to get or train a replacement.

WMC's definition of the scope of the industry does not cover all chemical activities, and the Manufacturing Chemists' Association, in early November, was undertaking to obtain a broadening amendment. The definition in Bulletin No. 24 reads: "This bulletin covers the following essential activities . . . (a) Production of chemicals and allied products: Glycerin; turpentine, rosin and other naval stores; wood tars, oils, acids, and alcohols; lubricating oils and greases; animal and vegetable oils; fertilizers; tanning materials; salt; synthetic rubber; primary coal-tar products; plastics; compressed and liquefied gases; refined sulphur; sulphuric and other acids; caustic and other sodas; industrial alcohols; electrochemical and electrometallurgical products such as carbide, sodium and potassium metals and high-percentage ferro-alloys; drugs and medicines; insecticides and related chemical compounds; nylon and other synthetic textile fibers used in military equipment exclusively; grease and tallow; candles. (Explosives, flares, and other fireworks, generally classified as chemical products are included with ammunition.)"

The Association also called to the attention of proper officials a number of changes it felt should be made in the occupational list. Particular objection was raised to the limiting sentence in the definition of "chemical operator" as "a title covering workers who actually operate equipment that requires the exercise of independent judgment, extensive responsibility for product or equipment, and the application of acquired skill, such as, autoclave operator, acetylator operator, still operator; it does not include operators who tend equipment in accordance with specific instructions, such as contact acid operator or drum filler." The Association also proposed that designation of several occupations by commodity, such as "filterman—paraffin," be changed to eliminate the commodity classification because of the endless variety of industry products.

Maximum Car Loadings

Maximum loading of railroad freight cars in compliance with Office of Defense Transportation specifications became mandatory on Nov. 1, after two previous false starts, under terms of ODT Order 18, Revised. Railroads are now forbidden to accept for shipment, cars not loaded either to full visible capacity or to marked weight capacity, with certain defined exceptions such as shipments of planes, tanks, guns, etc. Special exceptions also permit loading only to tariff minimums of commo-

dities which have been allocated or limited by Government regulation in such quantity as to preclude carload loading, and of shipments of explosives.

Accompanying the issuance of the revised order was a list of special loading specifications for a few specified commodities—for example, rosin in bags must be loaded to eight tiers high, lime to a minimum weight of 70,000 pounds, liquids in metal drums on end, one tier high, to cover the entire car floor. In an effort to keep the administration of the order to its simplest terms without defeating its purpose, the Manufacturing Chemists' Association, late in October, proposed that application be generally on a basis of types of containers rather than by individual commodities. Recommendations of the Association's technical committees included proposals that box carboys be loaded in three tiers (four boxes across the width of the car, three on the second tier and two on the third), multiwall paper bags to the marked capacity or practical stowage space, burlap and textile bags and slack barrels to the practical stowage space, tight cooperage barrels and metal drums for liquids (40 gallons or over) placed on end in one tier covering the entire floor space. Mixed containers including fiber boxes, it was conceded, could not be covered by a broad specification.

Rubber Program

There was speculation in Washington this past month to the effect that the rubber program might be revised to make greater use of alcohol from agricultural products in the production of butadiene. The reason advanced was that there was a shortage of butylene caused by the vastly increased program for 100 octane gasoline. The speculation got a cold reception at WPB although it was admitted that there might be some give and take between butadiene and gasoline from time to time.

There is one change in the rubber program that can be definitely reported. The policy now is to channel the available material for plant construction to one plant at a time so as to get the most output in the least time.

Conversion of the distilled spirits industry to the production of 190 proof alcohol for industrial use, which was scheduled to take effect on Nov. 1, actually was completed October 8. This was formalized a few days later by an amendment to Order M-69 prohibiting use of any distillery output for beverage purposes. The industry is expected to turn out about 240 million gallons of industrial alcohol in 1943.

With this conversion completed, the possibility is now being studied of using the California wineries in the production of alcohol for the rubber program. The conversion of the wineries might easily come to pass but the additional suggestion that a plant for the production of butadiene might be put up on the west coast has only a remote chance of fulfillment. Butadiene does not ship well so that unless facilities are provided on the coast for the complete process it wouldn't pay to put up any part of a plant.

Fats and Oils Deliveries

The delivery of fats and oils to the Army, Navy, and Lend-Lease was made easier by Amendment No. 1 to Order M-71 which also made some adjustments in the quotas for civilian use.

The original order, released late in September, established utilization restrictions and quantity restrictions or quotas to a percentage of the manufacturer's normal consumption. (*Chem. & Met.*, Oct. '42, p. 125.) The original order gave exemption from these restrictions to direct suppliers to the Army, Navy or for Lend-Lease but did not provide for the extension of the exemptions to the subcontractors. Amendment No. 1 provides a means of extending the exemption for the military and lend-lease to the lowest supplier on the ladder. Thus everyone is assured equal treatment in the establishment of quotas.

Effect is to improve the supply of fats and oils for war needs and reduce the amount that can be used for nonmilitary purposes. Schedule A of the order which fixes the amounts on a percentage of the base period is revised as follows: Margarine 110 percent; other edible products from 90 percent to 88 percent; soap except that made from foots from 90 to 88 percent; paints, varnishes and lacquers from 80 to 70 percent. Soap made from foots is raised from 119 to 150 percent.

Transportation Priorities

WPB has created a stockpiling and transportation division to handle all transportation priorities, with W. Y. Elliott, formerly chief of the Stockpile and Imports Branch, as director, A. F. Shafter, chairman of WPB's transportation committee, in charge of transportation and storage and Conant Brewer in charge of stockpiling and shipping.

The division will advise ODT regarding the relative importance of commodities for storage, determine transportation needs for movement of essential commodities and materials and insure importation of essential commodities for consumption and stockpiling by establishing necessary priority schedules. The division also will be responsible for safety of stocks of strategic materials in storage, and will guide other agencies regarding more effective use of warehouse facilities.

Current Controls Bulletin No. 53 from the BEW Office of Exports lists data relative to application for export of multiple commodities. It is necessary to secure only a single application for export license if the request is for related commodities destined to but one consignee for use in one country. A combination of commodities within integral groups in the published list may be entered on a single export license application. Chemical commodities in the specific groups listed below are included in this modified plan:

Commodity	Schedule B Number		
Naval stores	2110	through	2118
Oil Seeds (except hempseed)	2210	"	2220.98
All inedible oils and fats	2230	"	2249.98
All essential or distilled oils	2268	"	2280
Vegetable dyeing and tanning extracts	2311	"	2339
Coal Tar Products	8005	"	8069.98
Medicinals and pharmaceuticals.	8111	"	8180.98
Chemical specialities	8200	"	8299.9
Industrial chemicals	8300	"	8398.98
Pigments, paints and varnishes...	8401	"	8442
Fertilizers and fertilizer materials.	8505	"	8551.98
Soap and toilet preparations ...	8710	"	8770

WPB has banned the use of new or used steel shipping drums for packing approximately 200 food, chemical and petroleum products after Nov. 14, The action, in Order L-197, complements a formal statement from WPB's chemicals branch in mid-October warning the industry that it must not rely on a continued supply of containers using critical materials just because adequate substitutes have been developed, and suggesting redoubled efforts to find such substitutes quickly. Estimates indicate a shortage of 30,000 tons of steel drums for the fourth quarter of the year on an unrestricted use basis.

Coincident with WPB's action, the Office of Price Administration announced that except in special or unusual instances, upward adjustment of ceiling prices to permit producers to pass on to consumers increases in container costs would not be authorized. Shippers, OPA said, must thoroughly investigate the possibilities of using less expensive containers before seeking a price increase on the ground of having to switch to containers costing more than steel. An instance where OPA has granted relief from "substantial hardship," however, involves several manufacturers of sweeping compounds who switched from steel to plywood at a 100 percent increase in packaging costs.

The staff of William M. Jeffers, the WPB rubber czar, took shape during October with the appointment of the principal administrative and technical assistants. Deputy Director in charge of all technical aspects of the synthetic rubber program is Col. Bradley Dewey.

Working with Col. Dewey are E. B. Babcock, chief chemist for Firestone Tire & Rubber Co.; L. D. Tompkins, vice-president of U. S. Rubber Co.; Dr. E. R. Gilliland, professor of chemical engineering at M. I. T.; W. L. Campbell, vice-president of American Machine Defense Corp. and consultant to the Army QMC; Morehead Patterson, president of American Machine Foundry Co., and Ray P. Dinsmore, manager of development for Goodyear Tire and Rubber Co.

Dr. Donald S. Frederick receives the gold medal, which together with $1,000 constitutes the John Wesley Hyatt Award, from Dr. Lyman J. Briggs, Director, National Bureau of Standards

DR. FREDERICK WINS FIRST HYATT AWARD

For his work in adapting transparent, colorless acrylic plastics to the needs of American military aircraft, Dr. Donald S. Frederick of Rohm & Haas Co., Philadelphia, has received the first John Wesley Hyatt award to be made annually for outstanding contribution to the plastics industry. The award was conferred on Dr. Frederick at a dinner in the Waldorf-Astoria in New York Oct. 30, the presentation being made by Dr. Lyman J. Briggs, director of the National Bureau of Standards and member of the Committee of Award.

Prior to the successful development of large sections of Plexiglas, the methyl-methacrylate plastic used by Dr. Frederick and his associates, it was impossible to fabricate sections large enough to make a bombing plane's "nose." Now this material is used not only in those applications but also to form cockpit enclosures, gun turrets, broad windows, domes, and similar parts. In connection with Dr. Frederick's work, new methods had to be perfected to make large, transparent sections accurately curved to conform to the contours of a plane. Similarly, new fabricating methods were developed to form large two- and three-dimensional curved dome sections that would meet the high optical standards required.

This award, established by Hercules Powder Co. last year, was named for John Wesley Hyatt, who is credited with having been the inventor in 1867 of the first plastic—a mixture of nitrocellulose and camphor out of which came the present-day celluloid. In winning this award, Dr. Frederick received the Hyatt gold medal, designed by Paul Manship, and a check for $1,000.

Dr. Frederick, who was born November 13, 1910, at Hamilton, Ohio, received his bachelor's degree from Miami University in 1931. His graduate work was done at the University of Illinois where he received his master's degree in 1932 and his Ph.D. in 1934. Since that time he has worked for the Rohm & Haas Co., first in its research laboratories and then on semi-plant production of Plexiglas. In 1936 he was made sales manager of the plastics division, and since that time has also headed his company's technical sales and service forces.

The Committee of Award consists of Mr. Richard F. Bach, Dean, Education and Extension, Metropolitan Museum of Art; Dr. Lyman J. Briggs, Director, U. S. Bureau of Standards; Dr. Karl Taylor Compton, President, Massachusetts Institute of Technology; Mr. Watson Davis, Director, Science Service; Mr. Eric Hodgins, General Manager, *Time Magazine;* Dr. Harry N. Holmes, President, American Chemical Society; and Mr. Ronald Kinnear, President, Society of the Plastics Industry. L. T. Barnette, former editor, *Modern Plastics Magazine*, and now on the staff of the Hercules Powder Co., resigned the secretaryship of the award committee and was replaced by William T. Cruse, executive vice president, Society of the Plastics Industry of New York.

COMMITTEE NAMED TO AID IN WAR PLANT SAFETY PROGRAM

An advisory safety committee, composed of leaders in the field of accident prevention, has been established to assist the Army's Services of Supply in its campaign for expansion and intensification of safety measures in installations and plants producing war materials.

Members of the committee are: H. W. Heinrich, assistant superintendent, engineering and inspection division, Travelers Insurance Co., Hartford, chairman; Ernest W. Beck, supervisor of safety, United States Rubber Co., New York; and Ned H. Dearborn, vice-president and managing director of the National Safety Council, Chicago.

The committee will act in an advisory capacity to the Safety Section of the Internal Security Division, Office of the Provost Marshal General, Services of Supply, which is charged with supervision of measures to eliminate accident hazards and unsafe practices. It will assist in determining policies and procedures necessary to carry out this program, and will aid in unifying the efforts of all federal, state and private agencies.

K. L. HANSEN NEW PRESIDENT OF AMERICAN WELDING SOCIETY

At the annual meeting of the American Welding Society held last month in Cleveland, K. L. Hansen of Milwaukee was elected president for the ensuing year. Other officers chosen include David Arnott, vice-president and chief surveyor, American Bureau of Ships, New York, first vice-president; Isaac Harter, vice-president, The Babcock and Wilcox Co., Barberton, Ohio, second vice-president; and O. B. J. Fraser, director of technical service, International Nickel Co., New York, treasurer.

FOR PRODUCTION EXCELLENCE

Among the companies which, in the past month, have been awarded the honorary Navy "E" and joint Army and Navy "E" burgee for exceeding all production expectations in view of the facilities at their command, are included the chemical and explosives plants, the chemical process industries and the chemical engineering equipment concerns listed below. Other process and equipment plants will be mentioned in these columns as the awards are presented to the individual plants.

E. I. du Pont de Nemours & Co., Electrochemicals Department and the Chemical Warfare Service Plant, Niagara Falls, N. Y.
Eastman Kodak Co., Rochester, N. Y.
B. F. Goodrich Co., Hood Rubber Co. Division, Watertown, Mass.
E. B. Badger & Sons Co., Boston and Cambridge, Mass.
Indium Corp. of America, Utica, N. Y.
Texas Gulf Sulphur Co., New York, N. Y.
Allegheny Ludlum Steel Corp., Brackenridge, Pa., and Watervliet, N. Y.
American Welding Co., Carbondale, Pa.
Jessop Steel Co., Washington, N. Y.
Kennecott Wire & Cable Co., Phillipsdale, R. I.
Solvay Process Co., Hopewell, Va.
Johnston Steel & Wire Co., Worcester, Mass.
Parish Pressed Steel Co., Reading, Pa.
C. M. Kemp Mfg. Co., Baltimore, Md.
Bendix Aviation Corp., Eclipse-Pioneer Division, Philadelphia, Pa.
Combustion Engineering Co., Inc., Hedges-Walsh-Weidner Division, Chattanooga, Tenn.
Lapp Insulator Co., Le Roy, N. Y.
Bonney Forge & Tool Works, Allentown, Pa.
American Optical Co., Southbridge, Mass.
* Linde Air Products Co., New York.
* Wickwire Spencer Steel Co., Palmer, Mass.

* Received Maritime Commission "M" Award.

BRITISH PRODUCERS INCREASE OUTPUTS OF EXPLOSIVES AND CHEMICALS ESSENTIAL FOR MILITARY USE

Special Correspondence

PRODUCTION of chemicals for essential purposes continues to increase in the British Isles, and while further restrictions on the manufacture of goods for civilian use are imposed month after month, the demands of the armed forces and vital industries are met in a satisfactory manner. In the House of Commons Sir Andrew Duncan, Britain's Minister of Supply was able to state that "it is a long time since the supply of explosives gave us any trouble. In no case, at the present time, is the filling of shells, bombs, or cartridges in any way limited by the supply of the principal explosives." Of the total production of explosives in Great Britain something like 60-70 percent is now produced in eight ordnance factories which have thus become some of the biggest plant units in the chemical industry. But many of the raw materials for the manufacture of explosives are provided by private concerns, and these have met the demands made upon them to the full satisfaction of the authorities.

The "Battle for Fuel" attracts much attention in the British chemical industries which not only use large amounts of coal for fuel purposes but are interested in coal, shale and oil also as vital raw materials. Natural gas was not produced in Great Britain before the war, but the existence of certain deposits was established when the D'Arcy Exploration Co., a subsidiary of the Anglo-Iranian Oil Co., carried out a program of systematic prospecting in England and Scotland. Official consideration is now given to the possibility of utilizing the natural gas found then, and the yield of methane from some of these wells is said to be of an appreciable order. The main difficulty at present is the question whether it would pay to lay down pipelines from the wells to plants where the gas could be used. Meanwhile it has been suggested that methane gas might be produced in sewage works. The official attitude does not seem to be favorable to this suggestion, but in the changing conditions of today some attempt at the utilization of this source of energy may be made.

An interesting example of growing cooperation between coke-oven plants and gasworks is reported from Scotland where the Board of Trade ordered the gasworks of Glasgow, biggest town in the country, to take over the surplus cokeoven gas from the iron and steel industries in the area. This arrangement is bound to bring considerable advantage to the Scottish iron industry and to reduce materially the demand for coal in Lanarkshire. Further headway in this direction may be made in other parts of the country. As far as the chemical industries are concerned, a change-over from coal to gas which seems to follow from such arrangements is likely to increase the supply of important raw materials. Coal is the principal fuel material in the British Isles, and it has always been argued by chemical producers that utilization of the fuel value in the form of manufactured products after extraction of valuable raw materials for chemical processes is in the national interest.

On the Continent the development has gone much farther. There are now large long-distance distribution systems in various parts of Germany, and while these create problems of their own and may be overdone, there is no doubt that much scope is still left for cooperation in British gas producing industries. The Low-Temperature Carbonisation Ltd., the only company of its kind in England, reports that after having been compelled to work at only half capacity during the past year owing to a shortage of coal it views the outlook with more confidence since the Ministry of Fuel and Power has already given valuable assistance.

Substitute Oils

Some of the most important and most interesting substitutions have taken place in the field of vegetable oils. Groundnut and similar oils have taken the place of castor and olive oils in British textile dressing. A dressing soap may consist of little more than a soap made from groundnut oil and containing a large excess of the oil. Typical dressings for colored goods are 5-12 parts of this textile soap, 150-200 parts of dextrine, and 150-200 parts of magnesium sulphate (which often takes the place of lead sulphate). To give a glossy finish to fabrics 10 parts of soluble starch, 7 parts of glucose syrup, 1 part of paraffin or beeswax, 1 part of palm kernel or coconut oil, and 2 parts of textile soap may be used. For white cotton goods a typical dressing consists of 50 parts of starch, 30 parts of talcum or China clay, 5 parts of barium or lead sulphate, 1 part of soap, 2 parts of palm kernel oil, with a trace of ultramarine. Sodium and potassium soaps used for preliminary washes before fulling are now often made of whale oil fatty acids, though mainly for coarse goods. In some factories a fulling soap is made by acidifying the waste soapy water from other textile processes and distilling the fatty acids with a view to the elimination of unsaponifiable constituents.

To economize in the use of valuable raw materials for the paint industry new standard specifications have been issued for water paints and distempers for internal use, for paints which may replace oil paints, and for other painting work. Paint manufacturers have been advised to make use of antimony oxide for white paints, and China clay is now being employed on a larger

scale as a paint extender. One of the leading firms is marketing a new anti-corrosion paint prepared from a waste product which yields a wax-like substance with remarkable water-shedding properties. It is said that the new paint gives effective protection on any outdoor surface (iron, wood, stone, and concrete) and remains always elastic as it dries by evaporation of solvents and not by oxidation. It excludes water and moisture, and surfaces treated with it may, subject to tests now being carried out, be recoated with ordinary paint without danger of "bleeding". The new paint does not contain any imported oil.

An indigenous source of chrome ore for refractory bricks is now producing at a substantial rate in the Shetlands, chain of islands north of Scotland. A quarry was opened there some years ago and has produced since about 1000 tons of high-silica chrome ore consisting of an intimate mixture of chromite grains and serpentine gangue. In the manufacture of chrome-magnesite refractory bricks about 60-70 percent of coarsely-crushed chrome ore (containing 10-20 percent Ci_2O, 5-12 percent Al_2O_3, 12-18 percent Fe_2O_3, 20-30 percent MgO, 25-45 percent Cr_2O_3, 0-2 percent CaO) are mixed with 30-40 percent of finely-ground dead-burnt magnesite moistened with 5 percent of water and molded in a hydraulic press under a load of 15,000 lb. per sq.in. The bricks, having been dried in a tunnel drier at 60° C, are fired at about 1400° C. in down-draught kilns of the beehive type. The results are said to compare very well with those obtained in a chrome-magnesite brick made from Greek chrome ore.

Concentration of Production

Certain sections of the British chemical industry are now largely regulated by the Ministry of Food. A scheme has been drawn up for the rationalization of the technical fat-producing and bone-using industries by the Ministry, and a new company styled Fabon Ltd. has been formed as a private company without share capital. Its members—all the fat producing works in England and Wales—have been divided into two classes—"Nucleus" and "Dormant". The former will carry on with their manufacturing activities, while the latter close down for the duration of the war. Similar arrangements have been made for many other sections of the chemical industries which are either hindered by raw material shortage or excluded by the non-essential character of their products from making full use of their plants. The supply quota for cosmetics is now down to 20 percent of the figure shown for the year ended May 31, 1940. In order to encourage concentration it has been decided to allow firms which are domiciled in approved areas or have moved to these areas or which participate in satisfactory concentration schemes to produce up to 50 percent of their former output. This is a very important concession and will certainly speed up the

process of concentration which the authorities favor both because it sets labor free and because the factory space can be used to better purpose. It is clear that concentration and rationalization must assume more and more importance as compared with the quota system proper which may help to distribute the burden of war fairly over entire industries but in itself does not solve the resulting problems.

Once again fine chemical manufacturers are called upon to help in the utilization of indigenous herbs and drugs collected under government auspices. The output of vitamin C preparations is expected to be larger this year than ever before, but this will be necessary in view of the curtailment of normal food imports. In some respects a shortage of vitamin preparations is anticipated. In particular the supply of vitamin A gives cause for some concern.

Powder metallurgy as a means of saving critical metals has met with increased interest lately, and some importance is attached to the possibility of economizing in the use of tin for solders, bearings and alloys by the use of powders and pastes. Tin powder is produced by atomization, precipitation (with scrap zinc from a stannous chloride solution) and electrodeposition, but coarser powders may also be obtained by pouring the molten metal through a screen and allowing the globules to solidify or by heating and hammering tin with a comparatively large addition of lead. The advantage of tin solder pastes prepared from pure tin powder and powdered flux (like ammonium chloride) is that they can be evenly distributed over the heated metal surface.

SULPHUR PRODUCTION SETTING NEW RECORD THIS YEAR

Based on returns for the first eight months of the year, a new record is in the making for production of sulphur. The Bureau of Mines reports production for the Jan.-Aug. period this year at 2,379,137 long tons compared with 1,902,234 long tons for the like period of 1941. This represents an increase of about 25 percent although shipments from mines showed a gain of only 9 percent, the totals being 2,332,777 long tons for 1942 and 2,141,878 long tons for 1941. Producers stocks of sulphur at mines in transit, and in warehouses were built up from 4,685,843 long tons on Jan. 1 to 4,927,673 long tons on Aug. 31.

Production and Mine Shipments of Sulphur

(Long Tons)

	Production 1941	Production 1942	Mine Shipments 1941	Mine Shipments 1942
Jan. ...	233,391	297,019	213,319	211,307
Feb. ...	213,701	263,141	171,434	174,157
Mar. ...	240,487	277,829	139,608	339,399
Apr. ...	243,488	305,877	274,259	253,933
May ...	238,835	337,056	289,062	312,959
June ...	227,122	297,347	329,427	386,234
July ...	233,259	309,843	341,655	372,966
Aug. ...	271,951	291,025	383,114	281,802
	1,902,234	2,379,137	2,141,878	2,332,777

GERMAN CHEMICAL CORPORATIONS RAISE CAPITAL STOCK TO AVOID EXCESS DIVIDEND TAXES

Special Correspondence

EDITOR'S NOTE: *Cut off from direct correspondence with all except a few foreign sources in neutral countries, these notes interpret recent developments in continental Europe as reported in publications and official documents received in the United States. These monthly letters, prepared in this country, will be continued only so long as pertinent material of interest to American chemical industry is available for our comment and interpretation.*

CAPITAL "corrections" of German corporations averaging 20 percent have recently raised total capital of stock companies (A.G.'s or Aktiengesellschaften) by 3,000 million RM from 21,500 million RM. This increase reflects attempts to avoid paying the excess dividend tax, and, in the case of some of the larger companies, increased German holdings in occupied territories. The latter trend started in 1935 and was accelerated since 1940.

On the other hand, foreign capital invested in German enterprises has long been paralyzed by currency and other restrictions. In 1935, 16 percent of the total nominal corporate capital in the German chemical industry was held abroad as against an average of only 7.5 percent for all German industry. At that time U.S. capital was represented with 98 million RM in 15 companies, Belgian in 2 companies with 58 million RM, British in 7 with 53 million RM, Dutch in 10 with 48 million RM, and Swedish in 4 with 2 million RM.

For the year ending December 31, 1941, to come into line with the new dividend and capital stock laws, I.G. Farben, the largest German stock company, watered its stock by 25 percent, bringing its total common stock from 900 million RM to 1,125 million RM. Each 1,000 RM share was watered up to 1,250 RM. Dividend payments, however, remained unchanged in reality since the dividend rate was lowered from 8 percent in 1940 to 6 percent in 1941. In the meantime, another 235 million RM of stock has been authorized—presumably in large part to cover new holdings—so that the total I.G. Farben stock (including 40 million RM preferred shares) now stands at 1,400 million RM.

Although capitalization is not always an accurate index of the extent of operations of corporations in Germany, this does leave other companies far behind. Even after capital "correction," or "Aufstockung," as it is called, the huge steel concern Vereinigte Stahlwerke A.G., Dusseldorf, has a capitalization of only 460 million RM, Siemens and Halske electric concern 400 million RM. Capital stock of Friedr. Krupp A.G., Essen, is only 160 million RM, although this by no means represents the true size of this company. Incidentally, Krupp's board of directors includes Dr. Hermann Schmitz, new president of I.G. Farben.

I. G. Activities

The role of I. G. Farben in bilateral talks between the Reich and Southeastern European industrialists is reflected in the announcement that Dr. Max Idgner, I.G. treasurer, is to head the important special chemical committee within the German-Hungarian general committee (which he also heads) in the Reichsgruppe Industrie. In cooperation with Hungarian counterparts in Budapest, this committee is responsible for collecting and exchanging information and carrying out interstate planning in the chemical field.

Direct collaboration between I.G. and the Hungarian chemical industry is seen in the fact that at the beginning of 1942, "Chinoin," leading Hungarian manufacturer of pharmaceuticals and fine chemicals, in which British capital was at one time heavily interested, and I.G. were reported to be negotiating for the joint organization of a Spanish company to convert semifinished products manufactured by these two companies to eliminate competition in the Spanish market. Presumably agreements have been reached concerning other markets as well.

Spain in the past has had to import up to 90 percent of its fertilizer requirements. Since these are now largely unobtainable, I.G. Farben is reported to be installing for the account of Spanish steel interests, an ammonium sulphate plant. If completed in 1943 as scheduled, it should be able to supply 30 percent of Spain's nitrogen requirements. The effect of the present shortage of fertilizer in Spain is seen in reports that this year's orange crop is way below normal, and Spain's rice crop, which has been as high as 1.5 million tons, reached only 700,000 tons in the 1941-42 agricultural year. At El Pinar, construction has begun on a plant with a 200,000 ton annual capacity to produce superphosphates and sulphuric acid.

Spain is also reported to be processing more pyrites into sulphuric acid at home, partly because the transportation difficulties handicap pyrites exports. Processing of pyrites at home should permit recovery of small amounts of byproduct arsenic and copper, badly needed to make insecticides. Spanish copper requirements amount to around 30,000 tons a year. Domestic production since the civil war has averaged only 5,000 tons a year, and it is hoped to raise production to about 10,000 tons in 1942.

The Reich is pushing copper production in the former French-owned Bor copper mines in the Serb part of Yugoslavia, where plans are also under-

way to recover sulphur as a byproduct from copper ores. In the Croat areas of Yugoslavia German industrialists of Berlin and Duisburg have an interest in the Montan Handels A.G., a company recently capitalized at 500,000 RM in Zagreb (Agram) to trade in mining and smelting products and various fertilizers. In March 1942 the Chemische Fabrik A.G. was formed in Agram by a Croat group and the Verein fuer Chemische und Metallurgische Produktion, Prague, leading Czech company, to produce copper sulphate, sulphuric acid, superphosphate, and other fertilizers in this area.

Another important Croat agricultural corporation recently formed is the Zuckerversorgungs Gesellschaft Secerna A.G., capitalized at 50 million kuna, around which it is intended to build up a beet sugar industry capable of producing 30,000 tons sugar a year.

Beet sugar growers are the only persons eligible to use Chilean sodium nitrate in Sweden, where fertilizer rationing is now in effect. 80 to 85 percent of the 1940-41 supplies are being furnished in the year 1941-42. Each sugar beet grower who has contracted with the Swedish state sugar manufacturing monopoly can purchase 400 kilograms sodium nitrate for each hectare (2.47 acres) in sugar beets.

Denmark, after experimental production of alcohol from sugar beets, is planning to double output this year. Sugar beets are stated by the Danes to be cheaper for this purpose for them than potatoes and should eventually furnish the bulk of raw materials needed in Danish alcohol factories.

Germany fermented "melasse" sugar beet residues as a source of glycerine when supplies ran low in World War I. Undoubtedly, in addition to synthetic glycerine and ethylene glycol production, this same source is being used by the Reich again in this war. The shortage of imported oil bearing seeds which formerly supplied 90 percent of the Reich's technical fat requirements has sharply lowered the byproduct output of glycerine from soap production. Before the outbreak of the war, Germany's glycerine production was stated to be only 12,000 tons a year.

An alcohol source of growing importance is wood sugarization. At present there are believed to be over 20 wood sugarization plants in operation in the Reich. In addition to yielding alcohol, their output is being used more in an attempt to supply part of the huge deficit in cattle fodder in western Europe.

Cellulose Supplies

That the Reich's supplies of wood and cellulose are inadequate for all uses—partly because of transport difficulties but also because of increased demands for wood for mining operations and building bridges and fortifications in military areas—is evident from a recent decision to cut down the size of newspapers and magazines to

save wood pulp in the Reich. The Reich's wood consumption in 1938 was 69 million cubic meters and has increased greatly in the meantime, especially as a result of growing production of synthetic fibers and other products requiring wood as a raw material.

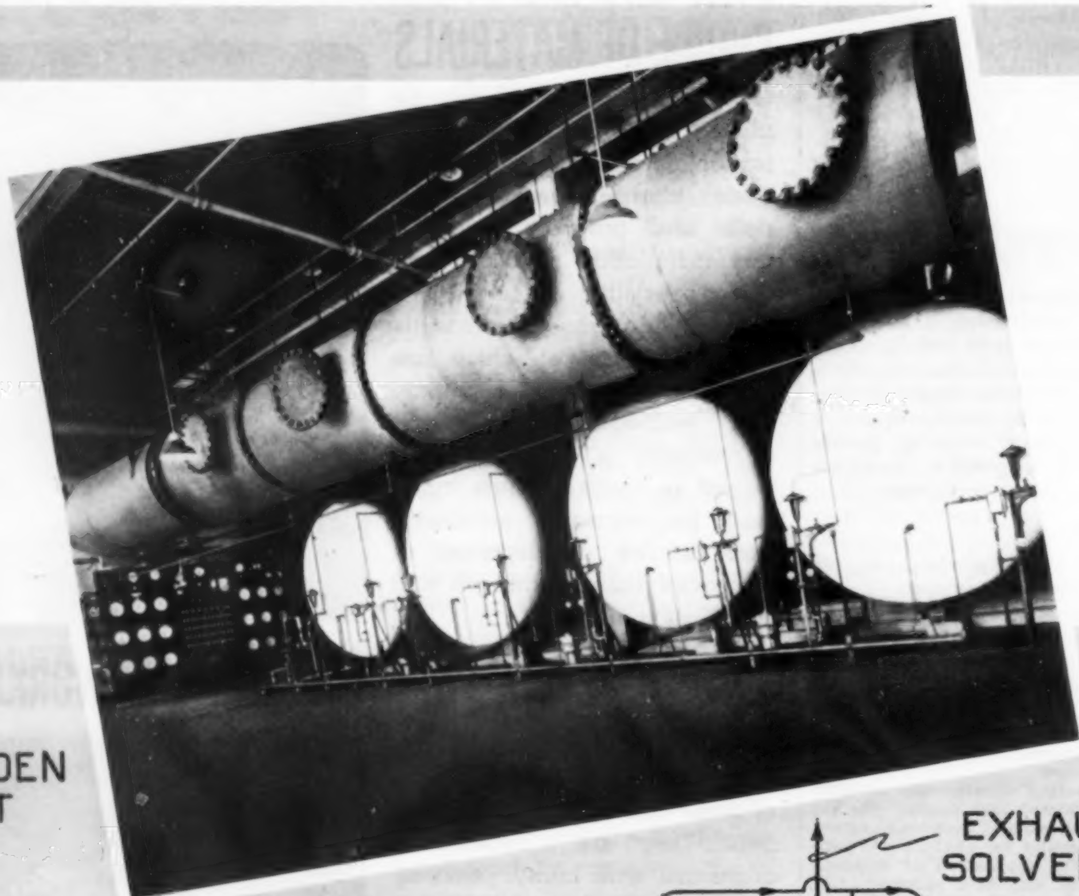
The intensification of mining even before the outbreak of the war raised the Reich's requirements for mine timbers from 3 million cubic meters in 1933 to 10 million cubic meters in 1938. In the same period, wood for burning purposes was cut down from 18 million to 14 million cubic meters.

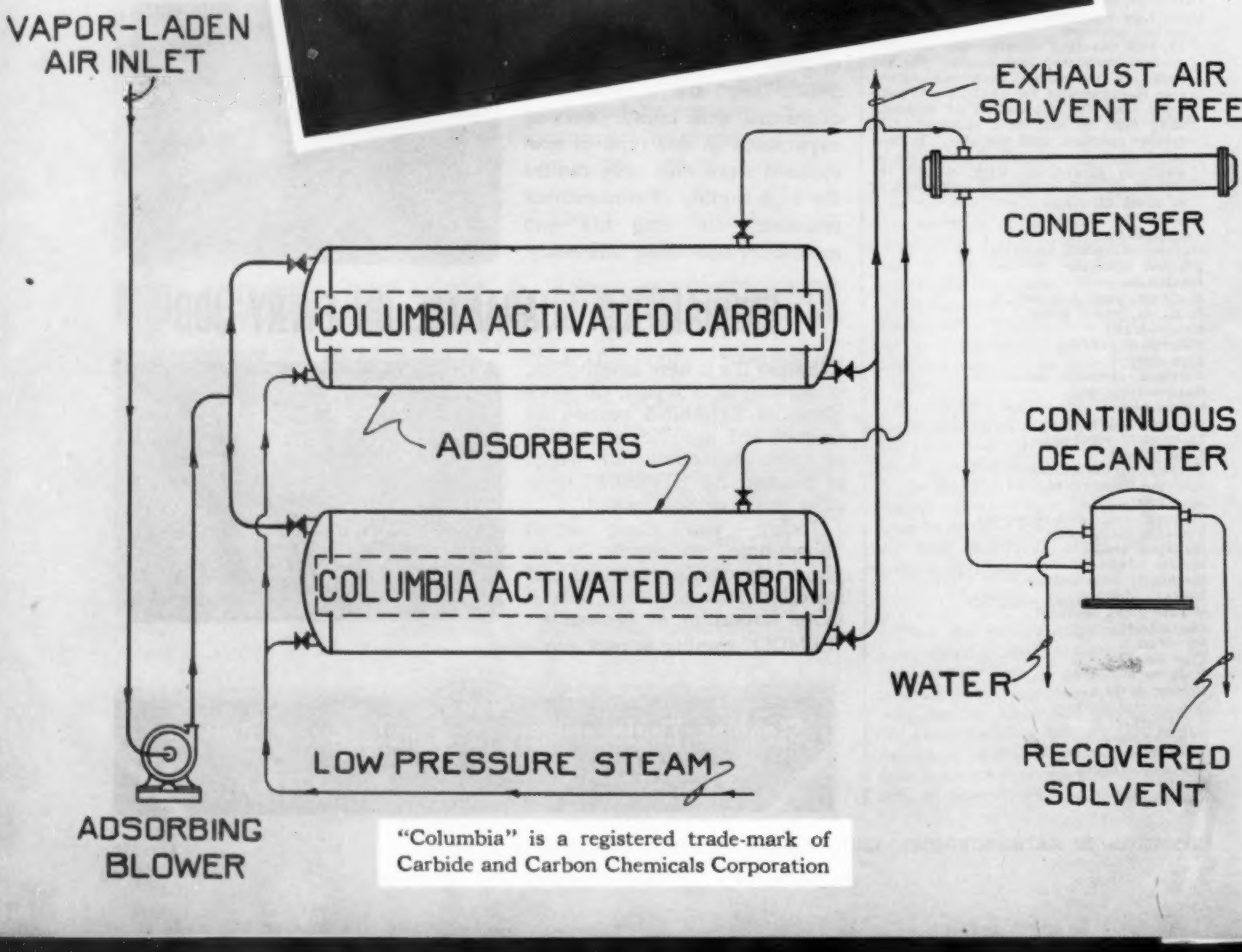
CRITICAL OCCUPATIONS IN PRODUCTION OF CHEMICALS

The War Manpower Commission has certified that production of chemicals and allied products is an activity essential to the support of the war effort. It has listed occupations in the production of chemicals which require a reasonable degree of training, qualification, or skill to perform the duties involved. The list is as follows:

Accountant, cost
Bacteriologist
Biologist
  Immunologist
  Nematologist
  Parasitologist
  Pathologist
Blacksmith
Bleacher operator
Bricklayer, ref.
Callendar operator
Carpenter, maintenance
Centrifuge operator
Chemical operator
  (A title covering workers who actually operate equipment that requires the exercise of independent judgment, extensive responsibility for product or equipment, and the application of acquired skill, such as, autoclave operator, acetylator operator, still operator. It does not include "operators" who tend equipment in accordance with specific instructions, such as contact acid operator or drum filler.)
Chemist
Coppersmith
Double-rolling-mill operator
Dialyzer operator
Electrician
Engineer, prof. and tech.
Engineer, power house
Entomologist
Filterman, paraffin
Fire chief
Foreman, chemical operations
Gas-producer man
Glass blower
Glycerin refiner
Instrument repairman
Lead burner
Lubricating oil treater
Machine fixer, rayon
Machinist
Manager, emp. and personnel
Manager, production
Manager, traffic
Master mechanic
Mechanic, maintenance
Molder, plastics
Oxygen-plant operator
Pharmacist
Physicist
Pipe fitter
Processman, rayon
Rubber coverer
Sheet-metal worker
Soap maker
Spinning-bath man
Tool-and-die maker
Viscose blancher
Welder
Yardmaster

HERE'S YOUR "BOARD OF CONTROL"





PERSONALITIES

Charles G. Meier

D. E. Pierce

✦ CHARLES G. MEIER, for nearly twenty years associated with the U. S. Bureau of Mines has been named to the supervisory staff of Battelle Memorial Institute, Columbus, Ohio. He will direct and correlate an enlarged program of fundamental research and will serve as advisor and consultant to the Institute's war research for the government and industry. Before joining the Battelle staff Mr. Meier was supervising research engineer of the Pacific Experiment Station, U. S. Bureau of Mines at Berkeley, Calif. where he had been in charge of the Bureau's fundamental research program. Prior to that time he was research fellow and subsequently assistant director of research at the University of Utah. Earlier he held industrial positions with The Carborundum Co., Niagara Falls, N. Y. and the Phelps Dodge Corp., New York City.

✦ ARTHUR S. ELSENBAST, vice president of Johns-Manville Sales Corp. and head of the company's filter aids and filter department was honored recently at a luncheon which marked his completion of 25 years with Johns-Manville. Mr. Elsenbast is a graduate of Cornell University and was vice president of the Celite Co. when that concern became a part of Johns-Manville.

✦ ESTHER A. ENGLE has accepted a position with the Technical Service Division of Commercial Solvents Corp., Terre Haute, Ind. The duties of this division include the introduction of the company's new products and the preparation of technical literature. Before joining the Commercial Solvents staff Miss Engle was head of the chemistry department of Cedar Crest College, Allentown, Pa., a position she had occupied for the past 14 years. She received an A.B. degree from the University of Illinois, a B.S. from Illinois Wesleyan University and an M.A. from Columbia University and has done further post-graduate work.

✦ D. E. PIERCE is now chief engineer of the Engineering Department of General Aniline Works. Mr. Pierce will have charge of engineering work at both the Grasselli, N. J., and Rensselaer, N. Y., dye plants of the company. He resigned from Charles Lennig and Co. several months ago to join the dye firm.

✦ HAROLD B. CALDWELL, vice president of Swenson Evaporator Co., has recently been given the additional responsibility of district manager of the Whiting Corp. in New York.

✦ ROBERT VAN IDERSTINE, formerly with the Barrett Division of Allied Chemical and Dye Corp., has been appointed a field representative for the Pfaudler Co., Rochester, N. Y. Mr. Van Iderstine is a graduate chemical engineer with degrees from Columbia University and the Polytechnic Institute of Brooklyn, N. Y. Other new representatives of this company are John A. Pontius, formerly with the York Ice Machinery Corp., and K. J. Lambert, formerly with Cherry-Burrell Corp.

✦ JAMES H. FRITZ, chief chemist of the Pulp and Paper Division, National Oil Products, Harrison, N. J., has been commissioned a first lieutenant in the Chemical Warfare Service.

✦ D. C. DAVIS, assistant professor of chemical engineering at Wayne University, and now research and development mathematician for the Michigan Alkali Co., Wyandotte, Mich., will continue the college credit and war training courses in nomography and empirical equations offered by Wayne in the evening.

✦ JOSEPH ROBITSCHEK has been engaged by The United States Stoneware Co. to take charge of their ceramic research program. He will make his headquarters at Tallmadge, Ohio. Dr. Robitschek has had many years of experience in the production of chemical stoneware and refractory materials in the leading ceramic manufacturing plants in Czechoslovakia, Belgium, France and Germany.

✦ ANDREW H. PHELPS has been elected vice president of the Westinghouse Electric & Manufacturing Co. Mr. Phelps joined Westinghouse in January, 1937, coming from the McGraw-Hill Publishing Co. where for seven years he served as sales manager and director of public relations. He was connected with the U. S. Chamber of Commerce for ten years having charge of all district offices and the field forces. In 1919, he served as executive secretary of the International Trade Conference in Washington.

✦ RALPH R. WENNER has resigned from the General Aniline & Film Corp. to accept a position with the Thomas & Hochwalt Division of Monsanto Chemical Co. He will be located in Dayton, Ohio.

✦ VIRGIL TWEEDIE has recently joined the research staff of Commercial Solvents Corp., at Terre Haute, Ind. Mr. Tweedie received the B. S. degree from the University of Missouri and prior to assuming his prsent position was doing graduate work at that institution.

✦ R. G. VERDIECK has joined the research and development department of Westvaco Chlorine Products Corp. Dr. Verdieck is a graduate of the Chemistry Department, St. Louis University. Another recent addition to the department is William C. Eastin, a graduate of the Chemistry Department, University of California.

✦ GEORGE M. MACHWART has left the University of Maryland to join the chemical engineering faculty of Michigan College of Mining and Technology at Houghton, Mich., as associate professor.

✦ ANSON R. KENDALL has accepted a position as assistant professor of chemistry at Michigan College of Mining and Technology at Houghton, Mich. Dr. Kendall was formerly professor of chemistry at Dakota Wesleyan University, Mitchell, S. Dakota.

✦ ERNEST R. EPPERSON has been named research instructor in the department of chemistry and chemical engineering at Michigan College of Mining and Technology. Mr. Epperson comes from Missouri State Highway Department, Bureau of Materials and Tests.

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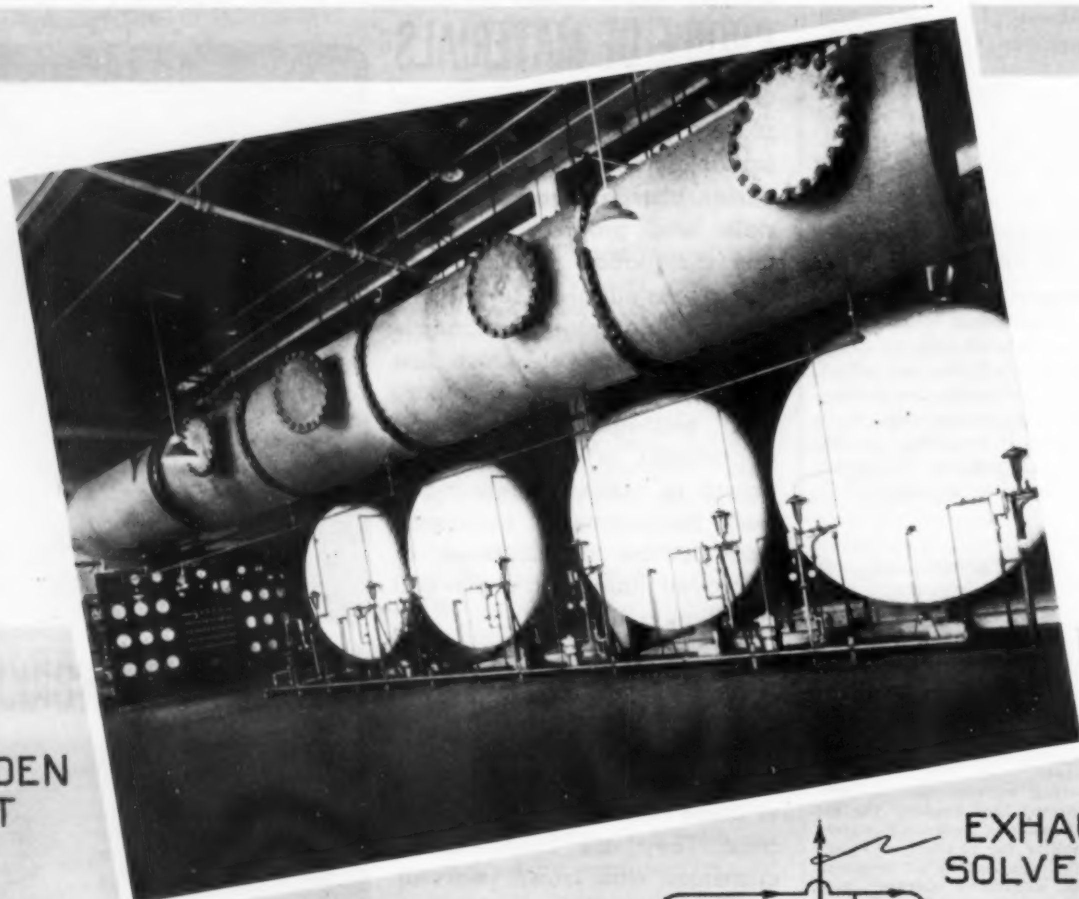

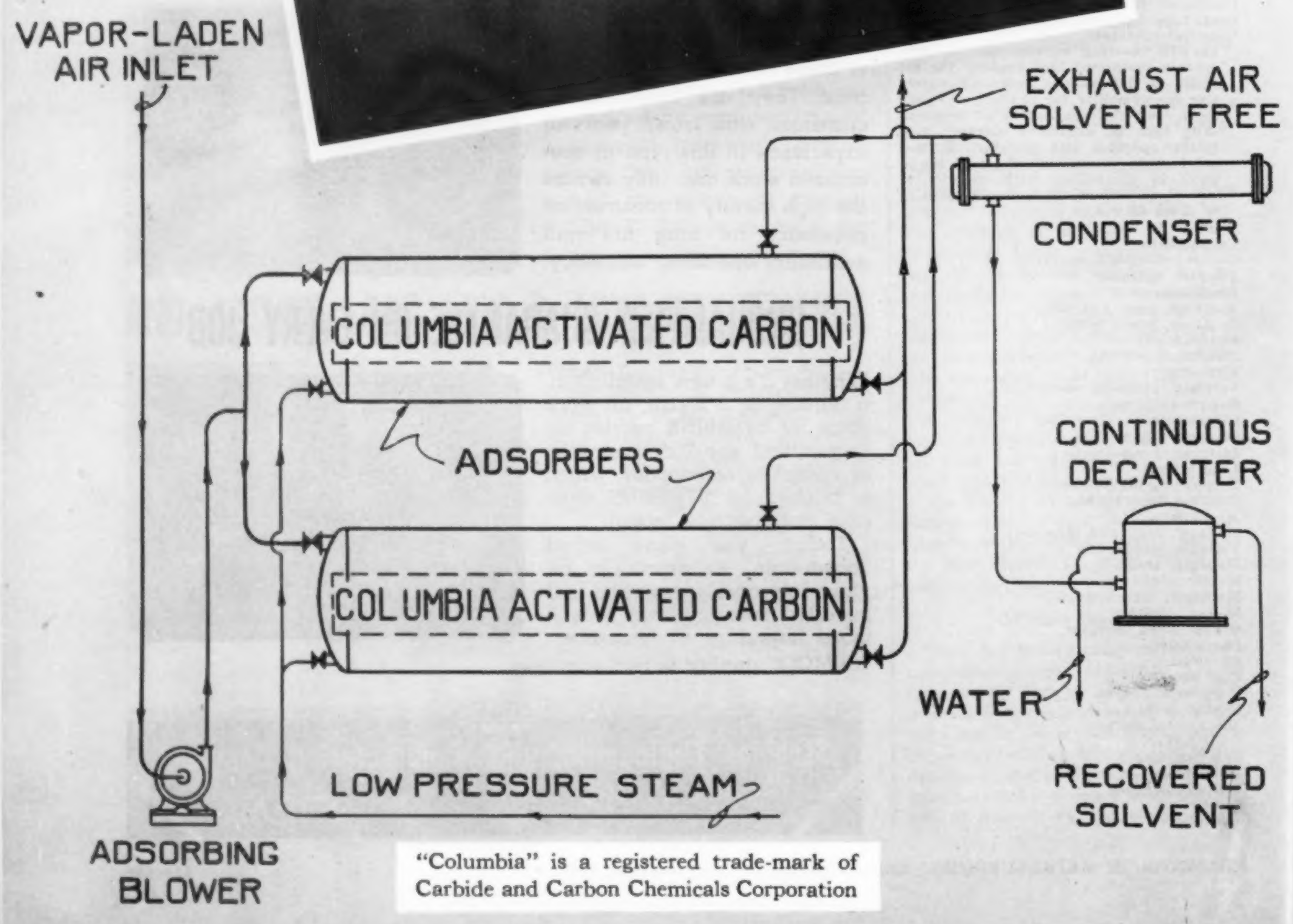

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ing engineering firm of Sessions & Sessions, Cleveland, Ohio, has been appointed chief engineer of the Brown Fintube Co., Elyria, Ohio.

✦ Charles F. Bonilla of the Department of Chemical Engineering of Johns Hopkins University has recently been appointed on the Board of Economic Warfare. Dr. Bonilla is on an extensive trip in Brazil. He received his graduate degree from the Electrochemical Department of Columbia University.

✦ Willard F. Schroeder, formerly of Kimberly Clark Corp., Kimberly, Wis., is now employed as control chemist for Rayonier, Inc., Fernandina, Fla.

✦ John Campbell is now research director for the Union Bag & Paper Co., Hudson Falls, N. Y. He was formerly with Reynolds Metals Co.

✦ Alexander Wilson, formerly chief of the Field Division Office of the Chief of Chemical Warfare Service, has been assigned to duty as commandant, Chemical Warfare School, Edgewood Arsenal, Md. General Wilson was born in Farmington, Mo., in 1886. He attended the U. S. Naval Academy, from which he resigned in 1908. He was commissioned a second lieutenant in the regular army on Feb. 11, 1911, promoted to the rank of permanent colonel, Dec. 1, 1939, and to brigadier general (temporary) Jan. 30, 1942. General Wilson served in France in 1918 with the 352nd Infantry, returning to the United States in May, 1919. He is a graduate of the Army School of the Line and the Army Artillery School, both conducted in France during 1918-19; the Motor Transport School, Camp Holabird, Md.; the Command and General Staff School; the Army War College and the Chemical Warfare School.

✦ Alden H. Waitt, formerly acting executive officer, Office of the Chief of Chemical Warfare Service, succeeds General Alexander Wilson as chief of the Field Division. General Waitt was born in Orlando, Fla., in 1892. He was graduated from the Massachusetts Institute of Technology in 1915, commissioned a temporary first lieutenant in the Sanitary Corps in 1917 and a first lieutenant in the Chemical Warfare Service of the regular army in 1920. General Waitt was promoted to the rank of permanent lieutenant colonel Oct. 9, 1940, to colonel, Army of the United States on Feb. 1, 1942, and to brigadier general (temporary) Sept. 13, 1942. General Waitt served in France in 1918 as chief gas officer of the 94th Division and later with the 29th Division. He served as secretary of the Chemical Warfare School from March, 1921, to January, 1924, and from July, 1934, to August, 1935. General Waitt is a graduate of the Gas Defense School, conducted in France; the Command and General Staff; and the Air Corps Tactical School.

✦ T. J. RHODES, formerly engineer with Procter & Gamble Co., is now with the United States Rubber Co. as chief of product control in one of their munitions plants.

✦ WILLIAM J. SIMPSON joins the engineering staff of Milton Roy Pumps. Mr. Simpson, a graduate engineer of Pennsylvania State College, and for several years design engineer for Baldwin Locomotive Works, Baldwin-Southwark Corp. and Brill Car Co., has joined the engineering staff of the pump company.

✦ H. A. ROTHSCHILD, technical director of Kimberly-Clark Corp., Neenah, Wis., has been named by the War Production Board as a member of the Paper Industry Technical Development Committee.

✦ L. S. JOHNSON, chief chemist of the Cornell Wood Products Co., Cornell, Wis., also is serving on this committee of WPB.

✦ H. P. BINDER is now manager of the Centrifugal Pump Department, of Allis-Chalmers Manufacturing Co., Milwaukee, Wis., according to the announcement of Walter Geist, president. Mr. Binder had been assistant manager of the Hydraulic Department in charge of centrifugal pump sales and engineering since 1940. He entered Allis-Chalmers direct from Purdue University in 1911.

✦ H. N. BROCKLESBY has been appointed to the scientific staff of the Special Products Division of the Borden Co. Dr. Brocklesby, former chief chemist of the Fisheries Research Board of Canada, where he directed chemical and biochemical activities at the board's experiment station, will make his headquarters at San Francisco, with the Farallone Packing Co., a Borden operation.

✦ ALAN N. FOUST, assistant professor in the Department of Chemical Engineering, University of Michigan, Ann Arbor, is now serving as Captain in the Chemical Warfare Service.

✦ FRITZ J. HANSGIRG, who developed the process for the production of magnesium carrying his name and used by the Permanente Corp., on the West Coast, is now teaching chemistry in a college at Black Mountain, N. C.

✦ S. D. KIRKPATRICK, Editor of *Chem. & Met.*, and president of the American Institute of Chemical Engineers has been elected an honorary member of the Chemical, Metallurgical and Mining Society of South Africa.

✦ JOHN M. MCGREGOR, formerly with Division of Soils at the University of Minnesota, has become associated with the Chemical Engineering Section of the Armour Research Foundation, Chicago, Ill.

✦ Francis J. Frere who was formerly with the Standard Oil Development Co. at Elizabeth, N. J., has recently been appointed to the chemical engineering staff of Armour Research Foundation. Dr. Frere will be in charge of the analytical laboratories recently established.

✦ John S. Wilson, who is connected with the Corn Products Refining Co., has been called to duty as ensign in the U. S. Navy.

✦ J. B. Duckworth has left the Research Department of the Standard Oil Co. of Indiana, at Whiting, to take up his duties as lieutenant in the Army Air Force.

✦ A. G. Oblad has resigned his position with the Standard Oil Company of Indiana, to accept a position in the Magnolia Division of the Socony Vacuum Oil Co. Mr. Oblad will be located at Dallas, Texas.

✦ William S. Morrell who, for several years has been associated with the Wright Junior College has joined the faculty of the University of Illinois as half time instructor in general chemistry, and half-time instructor in the general division. Next year Dr. Morrell will devote full time to the physical science work in the general division.

✦ Wm. Harty, a 1941 graduate of Montana State College, is now associated with E. I. du Pont de Nemours & Co. at its Charleston, W. Va., plant.

✦ George Gouker is now with the Raineer Pulp and Paper Co. at Shelton, Wash. Mr. Gouker graduated in 1940 from Montana State College.

✦ Willis R. Whitney, vice-president in charge of research of the General Electric Co. since 1928 has won the 1943 John Fritz medal it was recently announced. The award was made for distinguished research both as an individual investigator, and as an outstanding and inspiring administrator of pioneering enterprise, coordinating pure science with the service of society through industry.

✦ Harrison E. Howe, editor of *Industrial and Engineering Chemistry*, received the Chemistry Industry Medal for 1942 given by the Society of Chemical Industry.

OBITUARIES

✦ David W. Haering died recently of pneumonia in West Suburban Hospital, Chicago. He was president of D. W. Haering & Co. Mr. Haering was born in Chicago and educated at the University of Illinois.

✦ Archie F. Stock, director, vice president and comptroller of the American Agricultural Chemical Co., died October 20.

by using IRON BODY VALVES

Below—Iron Body, Bronze Mounted, Standard "Model Star" O. S. & Y. Globe Valve, with flanged ends, outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc. Made in sizes from 2" to 12", inclusive, for 125 pounds W.S.P.

Fig. 256

Fig. 241

Above—Iron Body, Bronze Mounted, Extra Heavy "Model Star" O. S. & Y. Globe Valve for 250 pounds W.S.P. Has flanged ends, outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc. Made in sizes from 2" to 12" inclusive.

VALVES

NEWS OF PRODUCTS AND MATERIALS

TRANSPARENT PLASTIC

The development of an entirely new transparent plastic having many times the abrasion resistance of other clear plastics was announced recently by Columbia Chemical Division, Pittsburgh Plate Glass Co. C. R. 39 is one of a group of resins resulting from many years of research activities. Its properties are such that it is in numerous ways far superior to similar products now in use. It does not dissolve in acetone, benzene, toluene, alcohol, gasoline, or any of the common solvents. Its resistance to abrasion is 10 to 30 times greater than other clear plastics. It retains its shape even when exposed to high atmospheric temperatures and can be formed into large sheets, either clear or laminated, by the application of extremely low pressures. In transparent sheets its strength, weight, clarity, and impact resistance are comparable with other transparent resins. In its primary form C. R. 39 is a clear, low viscosity liquid which, in the presence of a catalyst and heat, hardens into a crystal-clear solid. Layers of fabric, paper, and the like can be impregnated with the liquid material and cured under low pressure to form sheets or shaped objects with a minimum of expense for tooling. Ordinary plastics used in this way require pressures of from 50 lb. per sq. in. to many tons to produce a suitable laminated material. Since C. R. 39 is thermosetting and releases no gaseous or liquid byproducts when curing, it opens up a broad new field of plastic applications not satisfied by any other resin. Large flat sheets and intricate three-dimensional shapes can be made with almost equal ease.

WATERPROOFING CONCRETE

A water-repellent seal-coat for smoothing and waterproofing concrete has been developed by Paint-Point Corp., Newark, N. J. Concrete defects and porosity may be permanently sealed, leaving a perfectly smooth surface. The smoothing compound may be used for topping over new or old concrete surfaces. Just mix the material with cold water and apply with ordinary paint brush over any surface, wet or dry.

KAPOK OR SPONGE RUBBER SUBSTITUTE

Chemists have accomplished the feat of trapping air in a continuous stream of cellophane bubbles. The resiliency and buoyancy of the resulting product open up a large field of interesting possibilities. The material known as Bubblfil has been developed by E. I. DuPont de Nemours & Co., Wilmington, Del., whose rayon division is now manufacturing it in the Tennessee plant. Very large commercial scale must wait on war necessities, chiefly those in which it would take the place of Kapoc or sponge rubber. Tests already made show that the cellulose bubbles are fully as buoyant as the imported Kapoc, which comes from the seed pod of a Javanese tree. It has also been tried in the air compartment of life boats and life-rafts where Kapoc is no longer being used because of the limited supply. It is proposed for bridge pontoons, formerly filled with sponge rubber. If these air compartments are punctured by bullets or falling debris, the Bubblfil will keep the craft afloat. Neither Kapoc nor cellulose bubbles can be classed as nonflammable, but the bubbles will not ignite when struck by tracer bullets. This gives the Bubblfil a distinct advantage in military applications of many kinds. It is even possible to render the new material flame-resistant by chemical treatment. The material is also quite stable to extremes in temperature. Heating for three days in air at temperatures above 200 deg. F., and chilling to 28 deg. below zero F. did not break the bubbles. The material is so tough that its buoyancy was not affected when cheesecloth bags filled with it were subjected to an impact of 79 ft.lb. per sq.in., equivalent to the impact sustained by a light jacket worn by a 200-lb. man upon striking the water after jumping from a height of 55 ft. The resiliency of the cellophane bubbles, a property derived from the springiness of the entrapped air, has encouraged the company to study their suitability as a shock-absorbing material. Here Bubblfil might replace sponge rubber or so-called cellular rubber, so very scarce today. It has been formed by means of an adhesive material into mats and cushions. Chemically, it is the same material as cellophane or rayon, namely, regenerated cellulose made by the viscose process. The syrupy viscose material is extruded through a single spinneret hole relatively large in size. A small amount of air is injected into it at regular intervals just as the filament is coagulated by the acid bath in which it is being spun.

TEMPERATURE SIGNALING MEDIUM

One of the new products that was exhibited for the first time at the National Metals Show in Cleveland is a temperature signaling medium in liquid form. Tempilaq, employing the same principle as the Tempil pellets and Tempilstiks. The new product is available in a wide range of predetermined melting points between 125 and 1,600 deg. F. A thin smear or daub is applied to the working surface and dries in an instant. When the temperature stated on the bottle is reached, the smear liquefies sharply. On cooling it solidifies leaving a glossy or vitreous mark, distinctively different

from the original smear. This new material can be used with equal facility on glass, wood, ceramics or plastics as well as on metal, and is the more convenient form for use on polished surfaces, on the inside of tubes or castings. It is produced by the Tempil Corp., New York, N. Y.

TACK FREE SURFACES

Natural and synthetic rubber products can be rendered tack free by means of Hevealac, a liquid coating produced by Glyco Products Co., Inc., Brooklyn, N. Y. It can be brushed or sprayed on the finished rubber article, or in the case of small objects, they can be tumbled in a bath of Hevealac diluted if desired with denatured alcohol. The product is fast drying, and leaves a clear transparent flexible surface of high luster. Furthermore, it gives a continuous film resistant to gas to a considerable extent.

PROTECTIVE PAINT

As a further step in the consideration of vital metals, E. S. Phillips, president of Devoe & Reynolds Co., announced recently that his company has developed and is now producing Bar-Rust Metal Protective Paint. Production of this new paint is intended for the protection of exterior or interior surfaces of industrial plants or other structures having an appreciable amount of exposed metal. It is pointed out that the paint embodies three qualifications necessary for protection in the strictest sense of the word. They are:

1. The system includes a number of rust inhibitive primers which prevent the development of rust, and also grasp hold of the metal itself to provide a tough and elastic film which will expand and contract at the same ratio as does the metal over which it is applied.
2. The system includes a number of finish coat materials of different colors designed to go over the primers and stand up to an outstanding degree in the face of all exposures, interior and exterior, including rain, sun, sleet, ultra-violet and infra-red rays, industrial acid fumes, gas, etc.
3. Both primers and finish coat materials are so formulated that they will flow out in a uniform film thickness and have the ability to cling to the surface around sharp edges, rivet heads, bolts, etc.

GLYCERINE AND CITRIC ACID SUBSTITUTES

Substitutes for both glycerine and citric acid are now being manufactured by S. W. Landsberger, Whitestone, N. Y. Dr. Landsberger manufactured these products in Europe during the last World War.

TEXTILE FINISHING AGENTS

The development of a new product known as Avitone, a textile finishing agent, releases material now needed for military purposes, E. I. du Pont de Nemours & Co. announced recently.

The new finish is derived from petroleum. In the finishing of textile fabrics, large quantities of sulphonated tallow have been used to impart a pleasing finish. The same effect can now be achieved through the use of Avitone A. For textile purposes 100 lb. of this material will replace about 140 lb. of tallow, from which some 10 lb. of glycerin may be recovered.

PROTECTIVE FILM

A new compound with a chemically cured gelatine base and an organic compound is known as X90. Any continuous film of this on paper, wood, fabric or cement will prevent the penetration of any hydrocarbon, most gases, mineral and vegetable oils and fats. While maintained at moderate warmth (145 deg. F.), solutions of X90 may be poured, pumped, brushed, sprayed, or used to dip objects in. Prolonged exposure to a goodly amount of dry heat must follow for its proper drying, about 6 min. exposure to 250 deg. F., or a longer exposure to a lower heat. It is shipped as a concentrated solid. The manufacturer is Thomas W. Dunn Co., New York.

DEPLATING COPPER FROM SCRAP IRON

Virtually 100 percent of the copper in iron and steel scrap is recovered in a form satisfactory for direct use in electroplating important metal parts for military equipment in a recently developed deplating process by the Electroplating Division of E. I. du Pont de Nemours & Co. Large quantities of strip steel and iron may be made available for reuse by this process. Formerly, removal of copper plate was costly and most of the copper was wasted. Complete deplating under the new method is carried out rapidly under controlled operating conditions. Deplating takes place without attack of the base metal, in sharp contrast to usual stripping methods. Many war products are fabricated from copper-coated steel strip. Resulting scrap metal is useless until the copper has been removed.

PIPE JOINT COMPOUND

Industrial firms who have been using litharge and glycerin as a pipe joint compound and for other sealing applications have been demanding an efficient substitute which can be obtained in sufficient quantity to maintain plant efficiency. The X-Pando Corp., Long Island City, N. Y., has a compound that is said to be a substitute for litharge and glycerin and an improvement over this combination for use in ending pipe leaks permanently. It is stated that the compound expands as it sets. It is offered for use in ammonia, brine, oxygen and freon lines and works perfectly as a seal for all types of joints in all types of metal pipe. It is said that the compound resists deflection, high pressures and high temperatures. Its expanding action corrects imperfection in threads and makes flanged faces smooth. In spite of the fact that it expands as it

sets forming a leakproof joint, X-Pando pipe joint compound makes a joint which can be easily taken apart.

PAINT BRUSH BRISTLES

To synthesize a paint brush material with the taper, resiliency and toughness of natural bristle has been a goal of chemists for a quarter of a century. It became a national necessity to achieve that goal quickly after Pearl Harbor, for virtually all bristle had been imported from China and Russia. Nylon paint brush bristles recently announced for the first time not only have the required taper but also resiliency, toughness, length and inertness to paint ingredients. Moreover, they wear at least three times longer than natural bristles. The achievement of this tapered synthetic culminates five years of intensive research in DuPont laboratories. Today the government is preempting for military uses the entire output of a busy pilot-scale plant. Early next year two full-scale units are expected to be in production, but their entire output will be required by the military. Nylon paint brushes for civilian use must wait the end of the war. Four to five million pounds of bristle are required by this country's brush manufacturers in a normal year. More than half go into paint brushes, the remainder into toilet, industrial and miscellaneous brushes.

LESS LIGHT LOST WITH NEW GLASS

As a result of the use of a new and special chemical process, Libbey-Owens-Ford Glass Co. has announced a new glass having a lower percentage of loss of light due to reflection. By applying a reflection-reducing film on both surfaces of a pane of glass, the company has been able to reduce the loss of light from eight to less than one percent. While this is not a completely new discovery in the nation's glass industry, Libbey-Owens-Ford has developed a new and more practical method in this field of the treatment of glass by special processes. Light rays passing through a single pane of ordinary glass lose eight percent of their intensity as the result of reflecting or rebounding as they strike first one surface and then the inside of the other as they make their exit through the pane. As company officials explained, the recovery has been done by making the film "capture" the light rays which would ordinarily be reflected, and adding them to the transmitted rays for their exit through the second surface or other side. The chemical film having a coating of only six millionths of an inch in thickness, is so equally applied that there is no distortion of vision. Glass having this new chemical treatment has not yet been placed on the market or put into mass production.

PREPARED ISOMERIZATION CATALYST

Catalysts are ever becoming more important as a means of increasing production in the chemical industry. An-

nouncement has recently been made of Isocel by the Porocel Corporation, Philadelphia, Pa. It is said to be the only prepared isomerization catalyst. It consists of activated bauxite impregnated with 15 to 20 percent of anhydrous aluminum chloride. It has already proved itself a highly efficient and uniform product. Isocel enables the production of the desired quantity of isobutane from normal butane by the isomerization reaction. It makes aluminum chloride readily available to the refiner, dispersed on a hard porous carrier, and simplifies the utilization of this important catalyst.

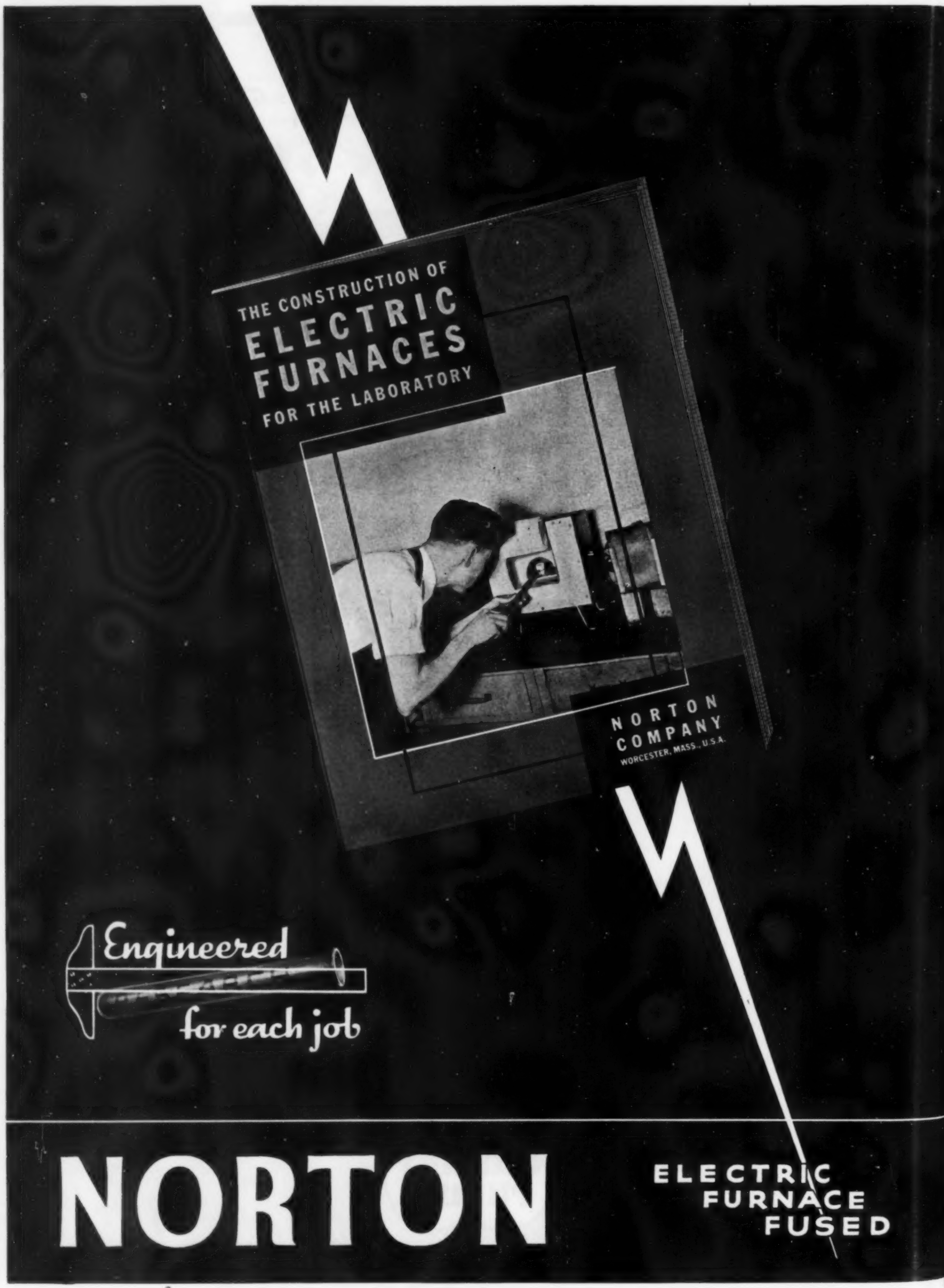
PREVENTION OF FOGGING OF SAFETY GOGGLE LENSES

To help keep safety goggle lenses from fogging, American Optical Co., Southbridge, Mass., announces a new type of Anti-Fog Lens Pencil. The new compound, according to thorough laboratory tests, secures superior anti-fogging results for a longer period of time than former types, and thereby adds to the efficiency of men working in steamy surroundings. In addition the pencil itself lasts longer without crystallizing and crumbling.

SURFACE COATING RESIN

Of particular interest to lacquer manufacturers is the announcement by the Plastics Division of Carbide & Carbon Chemicals Corp., New York, N. Y., of a new and improved type of vinyl copolymer resin for surface coating applications. The new resin, identified as Vinylite Resin VMCH, is characterized by a remarkably improved adhesion to a wide variety of surfaces, making possible the formulation of air-dry or low-bake coatings, which possess the same outstanding resistance to corrosive chemicals, to moisture, and to extreme weathering, shown by baked finishes based on the Vinylite copolymer resins. The new resin is quite similar to the other copolymer resins in most of its properties and differs only in containing a small amount of an additional ingredient that promotes the development of adhesion. It is completely compatible with the other grades and may be blended with them in actual use. The major field for finishes based on the new resins is believed to be in air-dry coatings for maintenance work, for coating industrial buildings and equipment exposed to very corrosive atmospheres, for coating and lining storage tanks to hold petroleum products, acids, alkalis or other corrosive materials, and for coatings that must withstand prolonged water soaking or extreme weathering conditions. Finishes based on Resin VMCH show excellent performance over magnesium and aluminum alloys, particularly on salt water immersion.

Relatively small proportions of Resin VMCH included in baking finishes based on the other copolymer resins permit excellent adhesion to be obtained at lower baking temperatures. It should find uses in metal finishes.


THE CONSTRUCTION OF
ELECTRIC
FURNACES
FOR THE LABORATORY
NORTON
COMPANY
WORCESTER, MASS., U.S.A.
Engineered
for each job
NORTON
ELECTRIC
FURNACE
FUSED

National Chemical Exposition Opens November 24 in Chicago

CHEM & MET

NEWS OF MEETINGS & CONVENTIONS

NATIONAL CHEMICAL EXPOSITION ANNOUNCES PROGRAM

PROGRAM FOR the 1942 National Chemical Exposition, to be held at the Sherman Hotel in Chicago, Nov. 24-29, has recently been announced. On Nov. 28 there will be a symposium on industrial war problems, presided over by C. S. Miner, of Chicago. Included are papers on control of wartime incendiaries by W. V. Evans of Northwestern University, waste treatment in industry as related to war economy, by F. W. Mohlman, director of laboratories, Sanitary District of Chicago, and salvage and conservation of chemicals in industry, by S. D. Perlman, of the Industrial Salvage Section of the War Production Board.

Other sessions will include the subject of plastics and paper, presided over by Norman L. Shephard of American Cyanamid Co., and food and the relation of food to the chemistry of plants and the soil, presided over by C. G. King, of the Nutrition Foundation, Inc. Also scheduled are papers dealing with the use of the electron microscope and the cyclotron in chemical research.

In addition, the War Production Board is preparing a special exhibit to demonstrate reclamation and recovery of solvents, paints, oils of all kinds, toluol and chemical by-products of various types.

NATIONAL ASSOCIATION OF MANUFACTURERS TO MEET DURING DECEMBER

THE 47th Congress of American Industry will be held December 2-4 at the Waldorf-Astoria in New York, William P. Witherow, president of the National Association of Manufacturers recently announced. The theme of the annual conclave will be "Making America Strong—War Power, Manpower, Peace Power."

Many chief executives of the War and Navy Departments, the War Production Board and other governmental agencies responsible for the prosecution of the war will be speakers at the Congress. The preliminary program, it was announced, included Donald M. Nelson of the War Production Board, William M. Jeffers, Rubber Administrator, Hiland G. Batcheller, head of the Iron and Steel Division of W.P.B., Paul V. McNutt, chairman of the War Manpower Commission, Leon Henderson, administrator of the Office of Price Administration, and Malcolm Muir, chairman of the N.A.M. War Committee.

Among nationally prominent industrialists to appear on the program is Wilfred Sykes, president of the Inland Steel Co., who will speak on the subject, "A National Labor Relations Policy." The field of science is to be represented by Dr. Robert A. Millikan, chairman of the Executive Committee of the California Institute of Technology.

Mr. Witherow has emphasized that the congress is no "brass hat convention." The program will deal with manpower problems, with questions to be asked from the floor that will be answered by a panel of prominent industrialists. Such subjects as labor supply, wage problems, developing supervision of workers, and employee morale will be frankly discussed.

MID-AMERICAN CHEMURGIC CONFERENCE MEETS IN CINCINNATI

THE THIRD Mid-American Chemurgic Conference of Agriculture, Industry and Science is scheduled to meet at the Hotel Gibson in Cincinnati, Ohio, November 17-18. Speakers for the luncheon on Tuesday will include Clarence O. Sherrill, city manager of Cincinnati and M. F. Taggart, director of research, O'Brien Varnish Co., South Bend, Ind.

Program for the general sessions includes addresses on the following topics: rubber from the farm by D. H. Doane, Doane Agricultural Service, St. Louis; processing synthetic rubber by Dr. R. V. Yohe, the B. F. Goodrich Co., Akron, Ohio; progress report on natural and synthetic rubber by Dr. Paul J. Kolachov, Joseph E. Seagram & Sons, Inc., Louisville, Ky.; better things for better living through chemistry by L. F. Livingston, Agricultural Extension Division, E. I. du Pont de Nemours & Co., Inc., Wilmington; essential oils as farm products by Dr. Ernest Guenther, Fritzsche Bros., Inc., New York; American-grown spices by M. L. Van Norden, Van Norden & Archibald, New York; industrial uses for tobacco by J. S. McHargue, Kentucky Agricultural Experiment Station, Lexington, Ky.; domestic sources for tanning materials by Dr. Fred O'Flaherty, Tanners Council Laboratory, University of Cincinnati.

Cellulose progress will be discussed by Dr. John Traquair, The Mead Corp., Chillicothe, Ohio; products from casein by Dr. F. C. Atwood, Atlantic Research Association, Inc., Newtonville, Mass.; industrial uses of castor oil by J. E. Good, Woburn Degreasing Co., Harrison, N. J. The films "A New World Through Chemistry" released by E. I. du Pont de Nemours & Co., Inc. and "Vinsol Resin for Concrete Highways" released by Hercules Powder Co., will be shown.

CONSULTING CHEMISTS AND CHEMICAL ENGINEERS ELECT OFFICERS

ELECTION of new officers and directors of the Association of Consulting Chemists and Chemical Engineers, Inc., was held at the annual meeting of the Association at the Chemists' Club, New York, October 27. H. P. Trevithick, New York Produce Exchange Bureau of Chemistry was elected president to succeed Louis Weisberg of New York. Other newly-elected officers included Albert P. Sachs, New York, as vice president; Henry M. Shields, Mid-Town Coal Labs, New York, as treasurer; William C. Bowden, Jr., Ledoux & Co., Inc., New York, as secretary.

New directors for three years each include: Philip P. Gray Wallerstein

CALENDAR

NOV. 16-18	American Institute of Chemical Engineers, 35th annual meeting, Netherland Plaza, Cincinnati, Ohio.
NOV. 24-29	National Chemical Exposition and National Industrial Chemical Conference, Sherman Hotel, Chicago, Ill.
DEC. 1-4	American Society of Mechanical Engineers, annual meeting, Hotel Astor, New York, N. Y.
DEC. 1-5	National Exposition of Power and Mechanical Engineering, Madison Square Garden, New York, N. Y.
FEB. 14-18	American Institute of Mining and Metallurgical Engineers, 157th annual meeting, New York, N. Y.

Labs, New York; I. F. Laucks, Laucks Laboratory, Seattle, Wash.; C. Weaver, Industrial Testing Labs, New York. Erwin Di Cyan of Di Cyan & Brown, Brooklyn, was elected for two years.

Realizing the difficulty to chemical industry caused by shortages of raw materials, needs for substitutes and new products and necessity of reorganizing, adapting and erecting plants, the Association of Consulting Chemists and Chemical Engineers, Inc., 50 E. 41st St., New York, has established as one of its functions a clearing house for consultants as a free service, referring those asking for assistance to consultants specializing in any given field. Within the past year the Association has received about 300 requests covering many different fields. Industry is urged to avail itself to the fullest extent of this free service.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT ELECTS OFFICERS

AT THE ANNUAL meeting of the Engineers' Council for Professional Development held on October 18, the officers elected for the term 1942-43 were as follows: chairman, Robert E. Doherty, S.P.E.E., president of Carnegie Institute of Technology; vice-president, Sidney D. Kirkpatrick, A.I.Ch.E., editor, *Chem. & Met. Engineering;* secretary, A. B. Parsons, secretary A.I.M.E.; and assistant secretary, Stephen L. Tyler, secretary, A.I.Ch.E.

Members elected to the Executive Committee for the following year include: W. B. Plank, A.I.M.E.; A. R. Stevenson, Jr., A.S.M.E.; J. F. Fairman, A.I.E.E.; B. F. Dodge, A.I.Ch.E.; J. B. Challies, E.I.C.; C. C. Williams, S.P.E.E.; C. F. Scott, N.C.S.B.E.E.

TECHNICAL MEETINGS NOW BEING SCHEDULED

AMONG THE TECHNICAL association meetings and conventions of interest to chemical engineers and industrial chemists now being planned are the following:

American Institute of Chemical Engineers, 35th annual meeting, Netherland Plaza, Cincinnati, Ohio, Nov. 16-18.

Canadian Institute of Mining and Metallurgy, 24th annual western meeting, Vancouver, B. C., Nov. 18-20.

National Chemical Exposition and National Industrial Chemical Conference, Sherman Hotel, Chicago, Ill., Nov. 24-29.

American Society of Mechanical Engineers, annual meeting, New York, N. Y., Nov. 30-Dec. 4.

National Exposition of Power and Mechanical Engineering, Madison Square Garden, New York, N. Y., Nov. 30-Dec. 5.

American Chemical Society, 9th annual Chemical Engineering Symposium, Palmer House, Chicago, Ill., Dec. 28-29.

American Chemical Society, 10th national Organic Chemistry Symposium, Boston, Mass., Dec. 28-29.

American Institute of Electrical Engineers, Winter convention, New York, N. Y., Jan. 25-29, 1943.

American Institute of Mining & Metallurgical Engineers, 157th annual meeting, New York, N. Y., Feb. 14-18, 1943.

SELECTIONS FROM CONVENTION PAPERS

USES OF SILVER IN WARTIME

PROHIBITION OF the use of nickel in industries considered non-essential curtailed the production of silver-plated ware but this factor, combined with the production of lower-priced sterling, has caused a large increase in use of silver in the arts.

Substitution of silver electroplate for nickel and chromium has added to the silver consumed. Use of silver brazing alloys had been steadily increasing prior to the war, but problems of metal joining in armament and ammunition manufacture and shipbuilding have accelerated the rate of increase.

Silver bearings in airplane engines are demanding increasingly large amounts of silver. These bearings are of electroplated, cast, or rolled silver, backed with steel. For electrical contacts the use of silver and its alloys, many made by powder metallurgy, have continued to increase.

Sterling silver, and to a certain extent the 800-fine silver-copper alloy (80 percent silver, 20 percent Cu) have

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Estimated Total Consumption of Fats and Oils in the Drying Industries, United States, 1937-41[1]

	1937	1938	1939	1940	1941
			Expressed in 1,000 lb.		
Linseed	570,788	479,813	548,876	575,524	784,329
Tung	143,470	87,405	103,051	66,921	69,780
Fish	44,340	29,781	42,570	45,967	55,514
Soybean	17,157	18,847	28,220	37,164	49,515
Castor	7,722	6,043	11,844	24,857	46,295
Oiticica	3,631	5,301	18,867	15,537	36,578
Perilla	38,776	41,487	50,960	19,023	8,130
All other vegetable	2,723	2,080	2,179	2,811	3,647
Total	828,607	670,757	806,567	787,804	1,053,788

[1]K. S. Markley, Southern Regional Research Lab., Bureau of Agricultural Chemistry and Engineering, U. S. Dept. of Agriculture, New Orleans, La., before the Inter-American Conference of Agriculture, Mexico, D. F., July 6-16, 1942.

Uses of Silver in the United States

In thousands of troy ounces
(American Bureau of Metal Statistics)

	1937	1938	1939	1940	1941
Coinage.......	15,940	6,509	20,192	21,239	55,064
Sterling ware...	10,800	9,100	11,200	14,400	30,000
Nitrate (largely photography).	12,500	11,900	12,750	12,000	18,000
Plated ware....	4,370	3,729	4,250	3,871	4,966
Unclassified....	3,830	2,271	5,800	10,729	27,034
Total......	47,440	33,509	54,192	62,239	135,064

taken the place of nickel and composition metal (nickel silver and various high-copper brasses and bronzes) as a base for rolled gold plate. The tenfold greater cost of the silver-alloy base for rolled gold plate has not been critical.

Silver alloys have been sometimes substituted satisfactorily for unavailable brass and bronze in such novelties as cosmetic containers, haberdashery furnishings, slide fasteners, and safety razors. Sterling silver can often be used in the tools designed for brass with only slight adjustments.

Scarcity of tin has made necessary the use of soft solders containing little or no tin, and the 97.5—2.5 and other lead-silver alloys have largely replaced the conventional tin-lead solders. With an annual soft solder consumption of about 100,000,000 lb., the potential consumption of silver is enormous even if its percentage in the solder is small.

Before the war, the chemical industry was using increasing quantities of silver because of its corrosion resistance. Interest in the use of silver-clad steel as well as pure silver and its alloys and the scarcity of stainless steel has widened the field. Actual use has been limited, one reason being the relatively high cost of these materials.

In April 1942, plans crystallized for the conservation of copper through the use of government-owned silver. Of the 3,280,000,000 oz. (about 100,000 tons), held in the Treasury, at first 40,000 tons and later a larger quantity was made available under certain conditions prescribed by the Treasury and agreed to by the Defense Plant Corp.

The first application considered was the use of about 13,000 tons of silver as bus bars in certain aluminum-reduction plants. Through cooperation between the copper refining and manufacturing interests and the leading aluminum producer, arrangements have been made for the casting, rolling into bus bars, and fabrication, installation, and use of the silver in aluminum plants under construction.

Another project is under way for the

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"The epic fight of the Royal Air Force to save England, raging month upon month against odds, was also a chemist's fight to produce better fuels. The Battle of Britain became a testing and development laboratory in which a Nation's life was the stake. The American chemist was in that fight because he knew more about motor fuels than any other chemist on earth. Where Germany stood in 1914 with coal tar, the United States stands today with petroleum."

use of about 150 tons of silver in certain transformers for government-owned plants. The copper industry is cooperating with the electrical industry in this case.

R. H. Leach and J. L. Christie, vice president and metallurgical manager respectively, Handy & Harman, New York, N. Y., before the Institute of Metals Division, American Institute of Mining and Metallurgical Engineers, Cleveland, Ohio, Oct. 12-14, 1942.

ELECTRODEPOSITION OF IRON-TUNGSTEN ALLOYS

Work has been conducted on a study of the electrodeposition of iron-tungsten alloys from a plating bath prepared by the addition of small amounts of sodium tungstate to the ferrous ammonium sulphate bath. Previous methods for the electrodeposition of iron-tungstate alloys were based on entirely new types of alloy plating baths.

This present work is the part of a general survey investigating possibilities of electrodepositing tungsten alloys from commercial plating baths which are modified by the addition of sodium tungstate. Its main purpose is to obtain information which may lead to a better understanding of the process by which tungstates are reduced at the cathode during electrolysis, although the possible importance of electrodeposited tungsten alloys is not being overlooked.

Iron-tungsten alloys have been electrodeposited from the ferrous ammonium sulphate iron plating bath which was modified by the addition of small amounts of sodium tungstate. Alloy composition and cathode current efficiencies were studied at various current densities, bath pH, and bath temperatures.

Tungsten content of the alloy was found to increase somewhat with: (1) increasing tungsten content of the bath; (2) decrease of cathode current density; (3) increase of bath temperature; and (4) decrease of bath pH. An increase of tungsten concentration in the bath was found to decrease the current efficiency of alloy deposition.

Most satisfactory alloy deposit was obtained from a bath containing 1-2 gm. per L. of added tungsten. A rather high current density, a bath pH of 2, and a bath temperature of 75 deg. C. were found to be the best conditions of electrolysis. It is suggested that reduction of tungstate ion at the cathode involves reduction of atomic hydrogen and/or by "unstable, active" iron.

M. L. Holt and R. E. Black, University of Wisconsin, Madison, Wis., before the Electrochemical Society, October 7-10, 1942.

FUSIAN CONTENTS AND EXCHANGE CAPACITIES OF SULPHONATED COAL FINES

Coal fines from the dust collecting systems at the coal mines have a negative value of approximately 30 cents per ton at the present time. This fine material is practically all coal and is not to be confused with mine wastes which contain large amounts of slate and clay.

Carbonaceous cation exchangers are

now produced from granular coal and are available commercially. It seems feasible that an exchange material could be produced from coal fines in a manner similar to that used for granular coal.

Fines were subjected to sulphonation either by SO_3, H_2SO_4, or fuming sulphuric acid. It was found that the action of the hot SO_3 produced a product of superior exchange capacity than when either H_2SO_4 or fuming sulphuric acid was used as the sulphonating agent. Fuming sulphuric acid was better than concentrated H_2SO_4, but the reaction temperature had to be maintained lower, in the case of the fuming acid, to prevent excess oxidation of the coal.

Exchange materials were obtained with capacities varying from 100-140 milliequivalents per 100 gm. of exchange material. It was not possible to determine the capacity of the material by the usual method of passing water of standard hardness through a column. This method failed because the material became too tightly packed to permit passage of the water. A reduced pressure apparatus was employed in order to overcome this difficulty.

There is very little agreement of data among research investigators on the chemical constitution and the capacity of the exchange material. However, it has been shown that there is a relation between the fusain content of coal fines and exchange capacity of the fines after sulphonation. Fines were investigated with fusain content ranging from 12-29 percent. It was found that coals having the greater fusain content have the greater exchange capacity.

It has also been found possible to recover the unused acid, which may be washed out after production of the exchanger and to use this acid for the regeneration of the exchanger.

R. C. Weast and A. M. Buswell, Illinois State Water Survey Division, Urbana, Ill., before the American Chemical Society, Buffalo, N. Y., Sept. 7–11, 1942.

SEPARATION OF VANADIUM PENTOXIDE FROM PHOSPHORIC ACID MIXTURES

TREMENDOUS DEMANDS at the present time for vanadium, principally for use in vanadium-alloy steels, present the necessity of increasing domestic production of that metal. Western phosphate rock has long been known to contain vanadium. In the production of phosphoric acid from phosphate rock, as a step in the manufacture of fertilizer, almost all the vanadium goes into the acid.

Detailed equilibrium study of the $V_2O_5.P_2O_5.H_2O$ system has been made at 10, 25 and 50 deg. C. The graphical representation of the results of this study have been shown to be useful in their application to the separation of vanadium as vanadyl phosphate from commercial phosphoric acid mixtures.

A method has been developed for recovery of V_2O_5 directly from vanadyl phosphate. It consists of dissolving the latter compound in cold water with

simultaneous addition of ammonia gas. A second method has been devised to recover ammonium vanadate by dissolving vanadyl phosphate in hot water and, after recooling, rendering the solution alkaline with ammonia.

A process has been proposed for the recovery of V_2O_5 from Anaconda phosphoric acid. It is based upon the oxidation of the vanadium contained in the commercial acid; its separation as vanadyl phosphate in accordance with solubility relationships shown by the equilibrium study; conversion of the vanadyl phosphate to ammonium vanadate as mentioned above; and finally the application of heat to the latter to drive off ammonia and leave as a residue the vanadium pentoxide.

A. W. Hixson and J. P. Morgan, Columbia University, New York, before the American Chemical Society, Buffalo, N. Y., Sept. 7–11, 1942.

THE CHEMIST IN THREE WARS

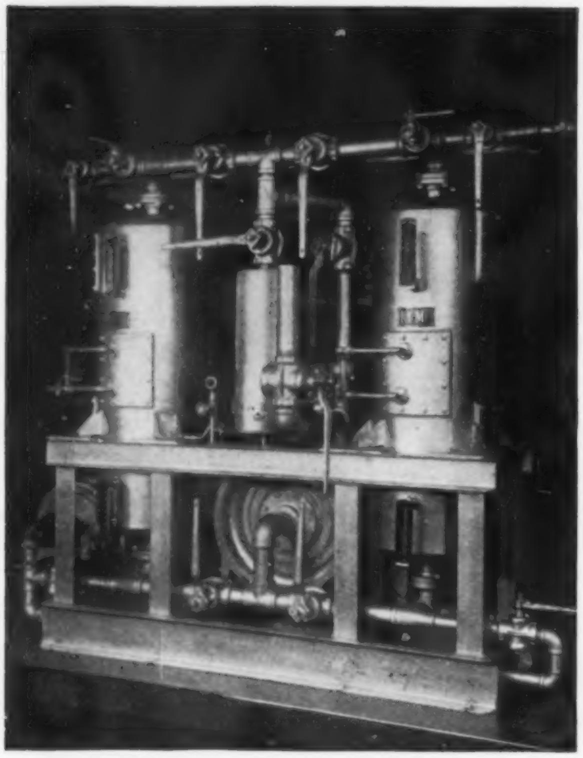
AT THE BEGINNING of the Civil War, chemistry was in its infancy. Chemical requirements of armies at that time were small; they comprised mainly a few basic materials such as iron, copper and saltpeter. Among manufactured products, gunpowder was the most important.

The Civil War—According to Census figures for 1860, the United States produced 884,474 tons of pig iron; out of this total the South contributed a mere 25,513 tons. Nevertheless, the Confederacy produced 50,000 tons annually during the war, a remarkable achievement in view of the fact that as the northern armies advanced many furnaces had to be abandoned. To augment this supply, collection of scrap iron was instituted early in the war. Lead was collected successfully from various sources, and 200,000 lb. were gathered from window weights in Charleston alone.

The only southern copper mines were located in Tennessee, but these soon passed into Union hands. Copper was sorely needed for bronze field guns and for percussion caps. The South solved this problem by buying up turpentine and apple-brandy stills, which were of copper.

In regard to saltpeter, the South was relatively well off. There were a number of deposits in limestone caverns which were mined under supervision of a special government agency called the "Nitric and Mining Bureau".

Direction of all chemical activities in the South was in the hands of three men, to whose energy and ingenuity history has accorded but scant recognition. These men were Josiah Gorgas, Gabriel J. Rains, and John W. Mallet. Gorgas was a graduate of the U. S. Military Academy who, as an officer in the Ordnance Division of the army, showed such outstanding ability that he was appointed chief of ordnance of the Confederacy in 1861. Rains was also a graduate of the U. S. Military Academy. The third man was Mallet, an Irishman who taught chemistry at Amherst and at the University



of Alabama. One of his principal assignments was the procurement of mercury, which proved difficult without any native sources of quicksilver. He remedied this situation by ordering the breaking up of all thermometers and barometers throughout the South. After the war, Mallet became professor of chemistry at the University of Virginia and in 1882 was elected president of the American Chemical Society.

In 1861, this trio of chemical engineers faced a desperate situation. Only two of the country's powder mills were located in the South: one in South Carolina, built for the sole purpose of furnishing powder for blasting tunnels, and one in Nashville, exposed to enemy attack. The South Carolina plant employed a crew of three men, the one at Nashville a crew of ten.

Gorgas immediately took steps to put the manufacture of powder on a solid basis. With Rains in actual charge, a large mill was started at Augusta in 1861; operations began seven months later. Rains even found time to improve the chemical processes. He introduced the method of steaming the mixed ingredients for gunpowder just before incorporation in the cylinder mills, which greatly increased the output, besides bettering the quality. When peace came, the Augusta plant was considered one of the most efficient in the world.

Lammot du Pont, the youngest member of the du Pont family who owned the large powder mill in Wilmington, was the outstanding chemical genius north of the Mason-Dixon Line. Lammot, then only 30 years old, had graduated from the University of Pennsylvania as a chemist at the age of 18. He had perfected and patented a process by which Peruvian sodium nitrate could be used for blasting powder in place of saltpeter. He succeeded, even during the war, in broadening the scope of his patented process so as to make it applicable also to the manufacture of gunpowder. The Indian monopoly of saltpeter was broken. The United States ceased to depend for its supply of saltpeter on a European nation or her colonies. Thus the Civil War laid the foundation for the military self-sufficiency of the United States.

World War I—World War I was characterized by one chemical achievement of such overwhelming interest that it outweighed all others: gas warfare. Aside from its novelty in modern combat, the introduction of this weapon carried with it the germ of a thought which, if it had been properly understood and interpreted, might have changed our entire conception of and preparation for warfare in general.

When the idea of a gas attack, on which German laboratories had worked for some time, was first submitted to the German high command it was received with disdain. It is said that only personal intervention by the Kaiser brought about a change of heart among the generals. Nevertheless, they immediately set out to sabotage it.

The proper procedure would have

been to call a conference of leading chemists, inventors, military officers and business executives to discuss the possibilities of this gas plan and perfect it before putting it to use. The business men, if men of vision, would no doubt have voted against its immediate adoption. Let there first be found a gas that was less visible, less odorous and not as easily identified as chlorine.

Months would have passed. Then the chemists would have substituted their improved product, phosgene. Invisible, insidious, highly poisonous, it would have broken the allied front; for no soldier can stand up against a weapon he cannot see and against which there is no defense. Of course, the attack would have to be carried out on a long front, 100 or 200 miles at least.

But the decision was not put into the hands of a board with vision. The Germans made their gas attack on a 3-mile front; they killed 5,000 Frenchmen and French Colonials, injured 10,000 and captured 6,000 more. That was all.

This happened on the 22nd day of April, 1915. On the 23rd, 100,000 gas masks, hurriedly made from cotton pads saturated with reducing agents and chlorine-reacting compounds, were on the allied front. The great peril was past. Germany lost the first World War because she did not recognize that war had become Big Business; she had no board of directors to conduct the war in a businesslike fashion. An invention which would have swung the balance was there, but its use was left to the discretion of one single department which muffed it.

World War I demonstrated that chemical ideas, properly utilized, can win wars. Above all, that war confirmed what the Civil War had indicated: war has become an enormous business and its direction should no longer rest exclusively on the military branch of the government; strategy, arms and manpower have ceased to be the only means by which war is waged. Equally as important is a Board of Directors to coordinate all branches and infuse into the whole structure the shrewdness, experience and all-around brainpower without which no big business can be successfully conducted.

World War II—One of the greatest needs of the country at the present is a complete roster of all chemical talent available. The present National Roster is not nearly complete. Preparation of a roster to cover our entire chemical brain power must be based on two indispensable conditions: (1) we must have a questionnaire which is properly worded; (2) this questionnaire must reach everyone who has useful knowledge or ability. Neither of these two conditions are now met by the national questionnaire.

We cannot afford to overlook those who have no chemical degrees or formal schooling. Some of our best inventive minds receive little or no college training, but have within them that spark which no amount of education can

supply. One of the finest chemists with whom the author has worked graduated from a little-known pharmaceutical college; and there are two men on his staff who never had more than high school training, but whose tangible achievements have made history in their particular field. The tendency still prevails in some circles to undervalue our collateral artisans. Nevertheless, without them the industrial chemist would be helpless. The author once had a foreman who could take a few pipes and couplings and turn them into almost any kind of apparatus needed. Such a man should be included on the roster.

The set-up to accomplish a complete mobilization of our chemical strength should probably be organized along the following lines:

(1) A supreme chemical council to govern all war work with representatives from all chemical branches, scientists, industrial chemists, practical men, and to be subordinated only to a National Board of Directors.

(2) A large number of trained chemical scouts, keen, imaginative and experienced to gather at the source whatever war problems present themselves, offensive, defensive or remedial.

(3) A nation-wide roster to include all chemical talent, college-trained or not, both inside or outside existing chemical organizations.

(4) Chemical groups covering each territory, modeled after a uniform pattern worked out by the National Supreme Council, to be in contact with each other as well as with headquarters and be associated in turn with working groups in collateral fields.

In the Civil War three chemists kept the South in the running until the end; one chemist in the North made the United States independent of the most critical foreign material. In the first World War, a German chemist almost decided the issue in favor of his country through one brilliant thought. Can we, at this critical time, afford to toy with our chemical potentialities and act as if we were preparing for a war five years hence?

Otto Eisenschiml, president, Scientific Oil Compounding Co., Inc., Chicago, Ill., before the American Institute of Chemists, Chicago, Ill., Sept. 18, 1942.

DESTRUCTIVE DISTILLATION OF LIGNOCELLULOSE

MANY INVESTIGATORS have destructively distilled hard and soft woods, pure cellulose, lignin, and agricultural waste materials and various theories have been advanced for the source and mechanism of formation of the various products obtained. Destructive distillation of lignocellulose compounds, other than the natural ones, has never been reported.

Compounds with different cellulose and lignin contents, as produced by a wood hydrolysis process, were therefore carbonized to determine the source of the various products. By varying the ratio of lignin and cellulose, a better understanding of the mechanism of distillation may be attained and applied to the treatment of naturally-occurring lignocellulose.

A cylindrical, hoizontal, gas-fired retort was used to carbonize various lignocellulose compounds. Pure cellulose, soluble lignin, and maple wood

were distilled also, so that a complete correlation of the sources of various products could be obtained.

The following conclusions were drawn from this work: (1) acetic acid is derived principally from the cellulose while ethanol is originated solely from the lignin; (2) hemicellulose in wood is the chief source of acetic acid; (3) soluble lignin forms larger yields of charcoal and non-condensible gases and a lower yield of total aqueous distillate than does cotton cellulose; (4) the various lignocellulose compounds give larger yields of tar than either cotton cellulose or soluble lignin.

Raphael Katzen, R. E. Muller and D. F. Othmer, Polytechnic Institute of Brooklyn, Brooklyn, N. Y., before the American Chemical Society, Buffalo, N. Y., Sept. 7–11, 1942.

REMOVAL OF TAR-FORMING CONSTITUENTS FROM PYROLIGNEOUS ACIDS

Hundreds of organic compounds have been identified in pyroligneous acids from wood distillation. Many of these polymerize to form tars and coke-like pitch at every successive stage from each of the various processes which have been used to recover methanol, acetic acid and other materials therefrom.

It was desired to find a method which would remove in a simple manner, with minimum adjustment of equipment and processing, substantially all the tar-forming materials in a single step early in the processing stages. Then the continuously plugging up with tars of heat transfer and other equipment could be obviated, and pure materials could be more easily made as finished products.

It was found that the treatment of the liquors with H_2SO_4 for a period of several hours resulted in the removal of practically all of the tar-forming constituents as fluid tar oils which could be removed without difficulty.

The processing was developed on a laboratory scale to determine the optimum conditions of acid concentration and time of treating liquors from various steps of the refining processes, then on a pilot plant scale, and finally on a plant scale in conjunction with one of the processes used for the removal of the methanol and acetic acid by distillation technique. In a plant handling 60 cords of wood per day, only a few pounds of H_2SO_4 per day and no additional equipment were required. A simple plant control method was developed.

D. F. Othmer and Raphael Katzen, Polytechnic Institute of Brooklyn, Brooklyn, N. Y., before the American Chemical Society, Buffalo, N. Y., Sept. 7–11, 1942.

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"With the number of research men in the field of synthetic rubber, with expenditures of millions of dollars yearly, one can feel confident that synthetic rubber tires will evolve with a life of at least 100,000 miles or, expressed another way, the tires may well outlive the motor car."

(*Continued from page* 109)

tive displacement meter, automatically corrected for volume change due to temperature to a standard temperature of 60 deg. F. A "repeat register" is provided, which can be set for delivery from 10 to 100 gal.

New apparatus for close fractionation of hydrocarbons, for use in plant control in the manufacture of synthetic rubber raw materials, toluene, etc., and designed for both automatic and semi-automatic operation, will be shown by Podbielniak Centrifugal Super-Contactor Co. This company plans also to exhibit a pilot-scale model of its centrifugal solvent extractor of 50 g.p.h. capacity.

Wartime conditions will prevent Proctor & Schwartz, Inc., from exhibiting actual equipment, but the company plans to show its latest developments in drying and dehydration machinery by means of photographs and drawings. Samples of the products made by the company's new food dehydration equipment will be on display.

Industrial gas burning equipment, specially designed for specific applications will be shown by the Selas Co., together with newly developed ceramic products of this concern, including a variety of micro-porous porcelain filters.

Ability to produce stainless steel castings to specifications for use in process applications will be the point put over by the exhibit of the Sivyer Steel Casting Co. The display will emphasize the company's production of castings that are true and machinable.

A.P.V. plate-type heat exchangers will be shown by Walker-Wallace, Inc. Special plates will be exhibited to indicate their adaptability to present-day requirements.

Rough, polished and machined castings of several corrosion resistant alloys, including Waukesha metal, will be shown in the booth of Waukesha Foundry Co., together with a number of models of this concern's slow-speed, non-agitating positive rotary pumps.

Emphasis of the Wheelco Instruments Co. exhibit will be on the interchangeability of parts in the company's Universal controller. Remote controllers for level, flow and interface, and flame controllers for furnaces, will be on display.

A variety of new testing and control instruments will be exhibited by Wilkens-Anderson Co. Included will be pH meters, spectrophotometers and photofluorometers, as well as equipment for test electroplating and de-plating.

A T & M Centrifugal Engineering Gives You The Whip Hand Over Process Time and Floor Space

Time slashed, manpower saved, operations combined or eliminated entirely are now directly resulting from the correct application of centrifugal force in extraction, filtration, dehydration, precipitation and coating processes.

Great advances have been made. A. T. & M. engineers, expanding and adapting the usefulness of centrifugal force, have destroyed old barriers, and built a broad, practical foundation for lowered costs, improved products, wider markets, through better engineered centrifugals.

For instance, one manufacturer, whose process involved the removal of two liquids from a solid, was unable to meet the competition of a substitute product — until A. T. & M. designed and helped plan the installation of special centrifugals which cut 7¾ hours from process time.

Another manufacturer, dehydrating crystals by a slow, laborious process, came to A. T. & M. to discover a speedier, alternative method. During preliminary consultation, it became obvious that an ordinary self-discharging centrifugal basket would not do the job. As a result of painstaking tests, a special centrifugal and framework were devised which not only speeded dehydration but also permitted immediate, conveyor-belt packaging during discharge.

In yet another case, costly after-filtering was eliminated by an A. T. & M.-designed 2-basket centrifugal. Clarification in the whirl of an imperforate inner basket removed the coarser solids. Then, by decanting the liquid over the edge into a perforate outer basket with a filter lining, the finer solids were removed — all in one swift, space-saving machine operation.

Today, A. T. & M.'s engineering service is naturally heavily engaged in the war effort. Yet, with a view to winning the peace as well as the war, our engineers' "know how" is at your firm's disposal for future planning, so far as national needs permit. Write us. We keep strict confidence. Address American Tool and Machine Co., 1421 Hyde Park Avenue, Boston, Mass., or 30C Church Street, N. Y.

A. T. and M.

AMERICAN TOOL AND MACHINE COMPANY

Link Suspended A T & M Smooth operation with "out of balance" loads. An A T & M-designed link guarantees absolute minimum of foundation vibration. Fume-tight covers; spray pipes; specials.

Suspended A T & M For heavy chemical service. Self-discharging baskets, Twin-Speed Regenerative Drive for entire batteries, positive control — and all other accessories when specified. Laboratory units.

Base Bearing A T & M Motors built to A T & M's own specifications. Removable baskets, if desired. Cover cannot open while centrifugal is in use. Easily accessible brakes. Outer casing of solid iron or steel.

SELECTIONS FROM FOREIGN LITERATURE

SWELLING OF CELLULOSE ACETATE

WHEN cellulose acetate films are swelled in aqueous phenol, both phenol and water are absorbed. Apparently the water absorption is strictly physical, not chemical. Effects of temperature changes and of salts such as sodium sulphate have been studied. It was observed that films of secondary cellulose acetate whiten and become translucent in 2 percent phenol solution. The whitening effect is intensified by washing out the phenol and drying the film. Whitening in phenol solution is accompanied by softening, and the film becomes more plastic than when dry or merely wet with water. This plasticizing effect disappears when the phenol is washed out. The original clarity of whitened films can be restored by replasticizing with phenol solution. These experiments are of interest in opacifying films or rayon, and in other connections.

Digest from "Swelling of Cellulose Acetate in Aqueous Phenol Solutions," by Ralph J. B. Marsden and A. R. Urquhart. *Journal of the Textile Institute* **33**, T105-34, 1942. (Published in England.)

TESTING WITHOUT DESTROYING

SINCE tools and machine parts have two sets of properties (one as structural entities and the other as component raw materials) their tests must be planned accordingly. It should be possible to test structural parts without sampling and even without demounting, so that defects arising in operation can be detected with minimum expenditure of time and materials. Available tests of this type are summarized in the accompanying table.

Digest from "Testing Materials Without Destruction," by E. Brandenberger. *Schweizer Archiv für angewandte Wissenschaft und Technik* **8**, 157-65, 1942. (Published in Switzerland.)

GAS PURIFICATION

TO COMPENSATE for the shortage of iron oxide purifier in gas plants experiments have been made with reburnt oxide. A mix which proved effective contained reburnt oxide 20, sawdust 3, ferrous sulphate 2 and slaked lime 1 cwt., made up with 55 gal. of water. Sawdust serves to lighten the mass, preventing back pressure, while the ferrous sulphate and lime form a precipitated iron oxide with exceptionally high activity. Freshly burnt oxide was compared with oxide which had weathered for periods up to 7 years. The newly burnt oxide apparently contained some soluble iron, which would yield a highly active precipitate with lime. This soluble iron had been largely or wholly leached out of the weathered oxide. On the other hand, weathered oxide was about twice as rich in combined water as newly burnt oxide, a factor which probably more than compensates the loss of soluble iron. Soda or ammonia may be preferable to lime as a source of alkali, since there is some risk of caking if calcium sulphate is formed from the lime. As a stronger alkali, however, lime gives somewhat higher activity than is imparted by soda or ammonia. In gas purification tests with about 150 tons of reburnt oxide gratifying results were obtained. Cost factors have not been evaluated, since the investigation was an emergency project, but presumably the use of reburnt oxide is more expensive than purification with Dutch or Belgian bog ore.

Digest from "Success of Burnt Oxide as Purifying Material," by G. Dougill. *Gas World* **116**, 177-9, 1942. (Published in England.)

FLANGED JOINTS

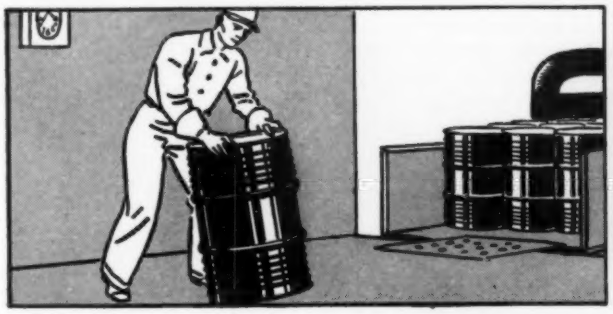
IN MAKING strength calculations from stress data for autoclave or pipe flanges due attention must be given to longitudinal stresses in the cylindrical portion. Calculations are also presented for shearing stresses at the boundary between flange and cylinder. Tangential and flexing stresses are given special consideration, and a numerical example of stress relations is utilized for discussing principles of autoclave design. Good agreement was found between calculated and observed longitudinal stresses in the cylinder. Agreement was also good for tangential stresses under certain conditions, but for some mountings there were discrepancies. Flange stresses present greater difficulty, but in general the

Summary of Non-Destructive Test Methods

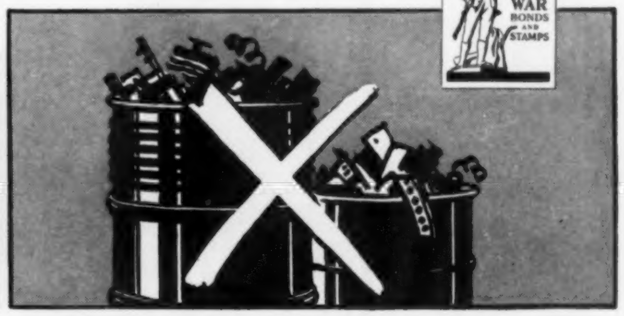
Test Method	Applicability	Maximum Penetration	Sensitivity
X-Ray irradiation	General	Fe, 150 mm. Al, 500 mm.	Fe (50 mm.), 1% Fe (100 mm.), 2%
X-Ray examination	General	Fe, 20 mm. Al, 50 mm.	Fe (15 mm.), 5–10% Al (50 mm.), 3–8%
X-Ray photography	General	Fe, 20 mm. Al, 50 mm.	a little higher than in visual examination
Gamma ray irradiation	General	Fe 70–250 mm. W 100 mm.	Example: Fe (150 mm.), 4%
Powder magnetism	Magnetic metals	slight	surface cracks, 1 micron wide
Magnetic induction	Magnetic metals	whole cross section	....
Electric tests, e. g. eddy current	Almost general	surface, or sometimes whole cross section	cracks, e. g. 1 micron wide
Ultrasonic	General	several mm.	....
Damping (elasticity modulus)	General	whole cross section	....
Vitroflux process	General	surface defects	....
X-Ray fine structure (wide angle diffraction interferences)	General	surface defects	sensitive to internal stresses

MAKE THE BEST OF WHAT WE HAVE

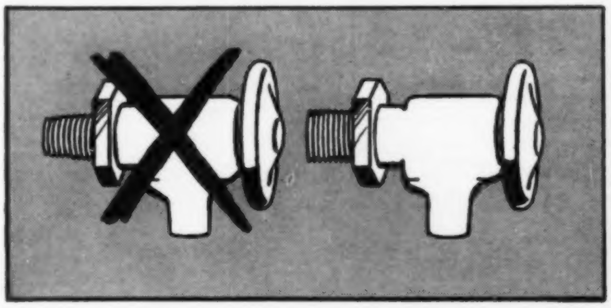
Drums and tank cars form the necessary supply line from the chemical manufacturer to your plant—without them it is impossible to ship the synthetic organic chemicals you need. Now it is more important than ever before that empty drums and tank cars be immediately returned—in good condition—to speed present deliveries and to insure future deliveries. To insure maximum use of every drum, please . . .



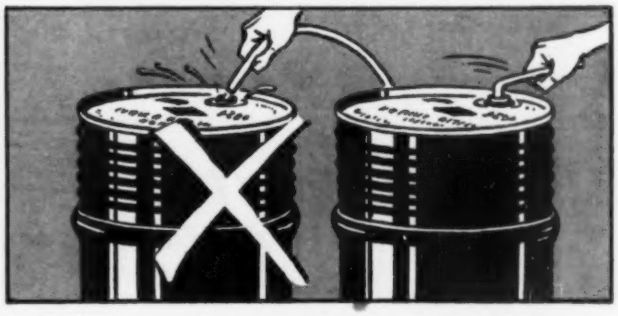
1. Return drums to the plant from which they came as soon as they are empty.



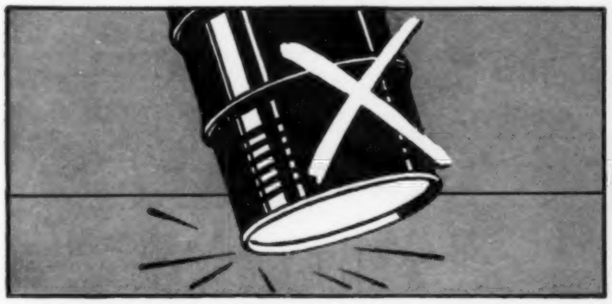
2. Don't use drums for transporting or storing other materials.



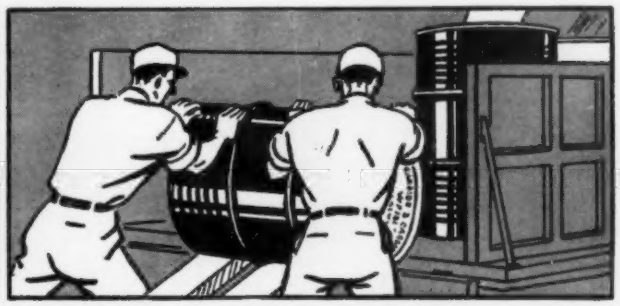
3. Use straight, threaded spigots. Tapered, threaded spigots tear out bungs.



4. Don't rinse empty drums. For return shipment just replace bungs tightly.



5. Handle drums with care. Dropping drums will spring the seams, and ruin them for further use.



6. Safety First! Always roll or hoist drums off and on trucks or loading platforms.

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calculated and observed values agree satisfactorily. At the flange-to-cylinder boundary and in the extended cylinder end stress calculations give only a partial and somewhat idealized picture of true relations. Some modified flange profiles are suggested.

Digest from "Calculating Sound Flange Unions for Autoclaves, Pipelines and the Like," by R. V. Baud, *Schweizer Archiv für angewandte Wissenschaft und Technik* **8**, 67-76, 122-9, 1942. (Published in Switzerland.)

FATIGUE IN LIGHT METALS

RESEARCH on fatigue in aluminum and its alloys has made significant progress but is still far behind the development attained by fatigue testing of iron and steel. Controlling factors include casting method, test piece dimensions, heat treatment history, physical treatments (rolling, sandblasting, welding and others), pickling and surface condition (oxide films, corrosion

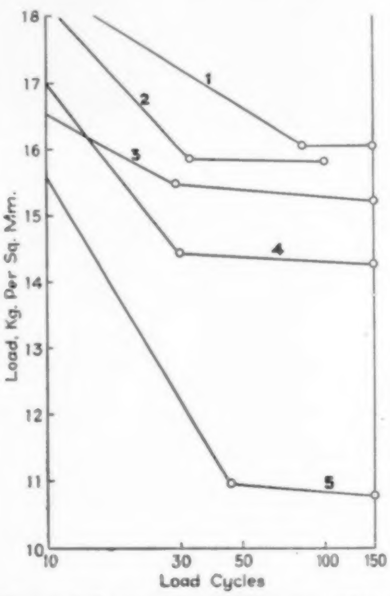

Fig. 1—Influence of pickling on fatigue strength. (1) Not pickled; (2) H_2SO_4 + NaF, water rinse; (3) Same, no rinse; (4) NaOH, water rinse; (5) NaOH, no rinse

state and the like). Notches, rivet holes and other discontinuities must also be considered. Because stresses vary so much in kind and intensity the stress must be accurately known and defined. Two types of flexing test are useful; one employs round rotating rods while the other employs flat test pieces clamped at both ends.

The influence of pickling on fatigue strength of round rotating Avional (Al:Cu:Mg) rods is illustrated in Fig. 1. The effect of rod diameter as shown for similar flexing tests in Fig. 2 shows

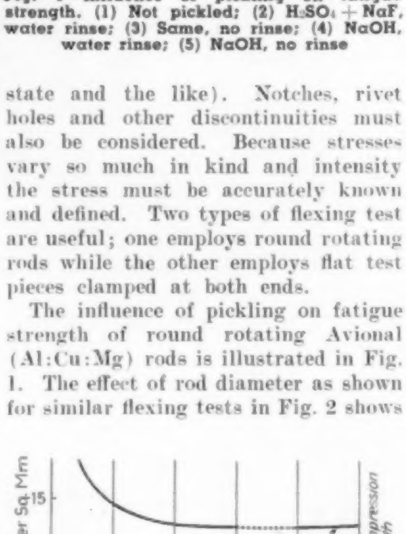

Fig. 2—Effect of rod diameter on flexing tests

that the lower limit is identical with the fatigue strength with respect to elongation-compression stresses. Numerous other factors are studied with respect to aluminum, Duralumin, Anticorrodal (Al:Mg:Si), Peraluman (Al:Mg) and Al:Mg:Mn alloys.

Digest from "Fatigue Strength of Aluminum and its Alloys," by R. Irmann, *Schweizer Archiv für angewandte Wissenschaft und Technik* 8, 52-63, 1942. (Published in Switzerland.)

ENGINE COOLING SYSTEMS

When modern high-speed engines are installed in power plants the cooling water which has served older, larger, slower engines with entire satisfaction may prove to be unsuitable. The high speed engine uses less cooling water, but is more exacting as to quality. Dissolved oxygen is a serious trouble maker because it accelerates corrosion. In a closed system oxygen in the water may be relatively harmless, but if the water passes over an open cooler it is repeatedly charged with fresh oxygen. Tannin preparations can be used effectively for absorbing oxygen. A thin black film of iron tannate is deposited on the metal surface, which thereby receives effective protection. When circulation of cooling water depends on a pump, and water stops circulating as soon as the engine stops, cooling will not be entirely satisfactory. Engines should be supplied from overhead tanks having enough water to run at least 20 min. in case of accidental pump stoppage, or to circulate water for a time after the engine stops.

Digest from "Trouble in the Cooling System," by F. D. Langley, *Gas and Oil Power* 37, 160-2, 1942. (Published in England.)

CAKING POWER OF COAL

Tests made by the Midland Coke Research Committee show that the swelling power of coals, being influenced by hydrogen content as well as by carbon content, is more directly proportional to heat value than to carbon content. Since swelling power is the best single criterion of performance in coke ovens or gas producers the B.S. crucible swelling test is recommended as the simplest in a selected list of swelling tests. It is also the most informative, but no single swelling test is sufficiently accurate and reliable to serve as the sole criterion of caking or swelling properties. If the swelling test conforms with analytical data for a coal it can be accepted; if not the coal should be investigated for fusain or durain and the analysis should be checked before judging the coal from its swelling behavior. Durain, whatever its composition, is always a nonswelling component. As volatile matter rises above 16 percent high grade coals develop agglutinating power. The agglutinating index is low if hydrogen content is below about 4.8 percent, probably because the tar yield is then barely sufficient for coke formation with little left over to wet the admixed sand. Above 5 percent hydrogen the agglutinating index is influenced by hydrogen as well as carbon, but as

oxygen content increases its influences becomes stronger until it entirely dominates that of hydrogen.

Digest from "Caking and Swelling Power of Coal," by R. A. Mott. *Fuel in Science and Practice* 21, 51-62, 80-8, 1942. (Published in England.)

RESERVOIR CONTROLS

For practical purposes, in operating volumetric or hydraulic controls for oil wells, the volume: pressure relation is expressed by the equation $Ve=KP$, where Ve is rate of oil production in units of volume and time, K is a constant and P is the effective working pressure. For simplicity an oil reservoir is assumed to be a wide flat disk holding liquid under a hydrostatic head corresponding to the underground depth. The effective working pressure is equal to the closed-in pressure at a depth opposite the producing sand minus the back pressure against which oil is being taken from the well. Calculations in which the pressure was taken only as the head lost across the orifice brought out an apparent anomaly which disappeared when the head lost across the sand was also considered. The correct equation was found to be $Ve=K'P'\ K''P''^{1/2}$ where P' is the pressure drop across the sand and P'' is $P-P'$. But in producing oil from wells under volumetric or hydraulic controls P'' is negligible and the equation takes the simpler form $Ve=KP$.

Digest from "Reservoirs Under Hydraulic and Volumetric Controls," by A. H. Nissan. *Journal of the Institute of Petroleum* 28, 146-57, 1942. (Published in England.)

CETANE NUMBERS OF HYDROCARBONS

Fuels for diesel engines have been tested for cetane number with several alkylbenzenes or derivatives thereof as blending ingredients. The results confirm the general parallelism between octane number and cetane number, in that fuels with a high octane number have a low cetane number. It was found that *n*-dodecylbenzene and *n*-tetradecylbenzene have the cetane numbers 68 and 72 respectively. Their blending curves with a low standard reference fuel (cetane number 18) are linear. Diphenyl, diphenylmethane and dibenzyl were also tested. They all boil within the diesel fuel range and have low cetane numbers; therefore they were tested only as blending ingredients. Their influence on cetane numbers is illustrated by the table, which shows the results of blending with a high standard reference fuel (cetane number 70.5).

Digest from "Evaluation of *n*-Alkylbenzenes and Certain Related Hydrocarbons as Diesel Fuels," by T. Y. Ju, C. E. Wood and F. H. Garner. *Journal of the Institute of Petroleum* 28, 159-71, 1942. (Published in England.)

Cetane Number of Reference Fuel After Adding the Indicated Weight Percent of Blending Ingredient

Hydrocarbon	Weight Percent					
	50	40	30	25	20	10
Diphenyl	—	—	—	—	61	67
Diphenylmethane	41	48	—	57	—	65
Dibenzyl	—	45	51	—	59	—

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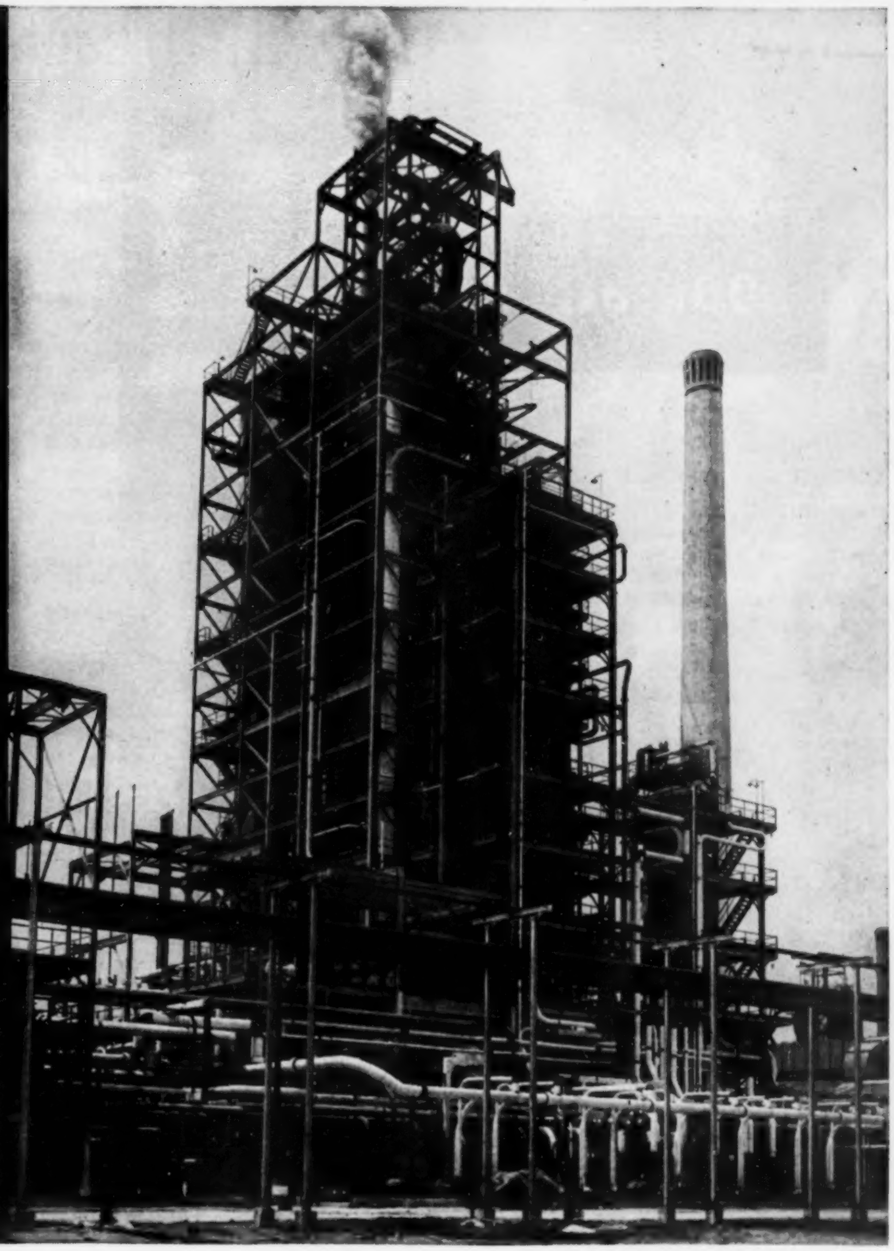

Photo courtesy of Standard Oil Co., of New Jersey

Already, B&W engineers have assisted in the design and construction of several plants for the production of synthetic rubber ingredients. Last year, B&W completed and published 157-page Technical Bulletin No. 6-D, "Properties of Carbon and Alloy Steel Tubing for High Temperature — High Pressure Service". And in the wide range of B&W Croloys are analyses that meet all needs for seamless alloy tubing in the production of butadiene, styrene, and other refinery products for synthetic rubber manufacture.

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THERMAL AND CATALYTIC METHODS

ISOMERIZATION OF PURE HYDROCARBONS. By *Gustav Egloff, George Hulla* and *V. I. Komarewsky*. Published by Reinhold Publishing Corp., New York, N. Y. 499 pages. Price $9.

WITH ISOMERIZATION processes rapidly assuming increasing importance in petroleum, synthetic rubber and organic chemistry technologies, it is fortunate that such a book has been published to summarize and classify our present knowledge on the isomerization of pure hydrocarbons. As additional data are made available, such organization will become of increasing importance to prevent our chemists from becoming drowned in their own knowledge. The terrifying possibilities are shown simply by the fact that in the paraffin series alone, the number of possible isomers ranges from the known two of butane to the predictable 62½ trillions of the 40-carbon molecule.

This monograph deals with the basic isomerization reactions for the alkanes, alkenes, alkadienes, alkapolyenes, alkynes, alkadiynes and alkapolyynes, cyclanes, spiranes, bicyclanes, polycyclanes, cyclenes, bicyclenes, polycyclenes, and the aromatic hydrocarbons. The authors review the mechanisms of both thermal and catalytic methods.

Available experimental data have been calculated to a uniform basis wherever possible. A comparison of catalyst concentration, time, temperature, pressure, and yield of products for more than 1,700 experiments on isomerization are shown in 182 pages of tables. An appendix contains translations from Russian and German on iso-alkane determination and a digest of representative patents on isomerization of hydrocarbons.

PRACTICAL FURNACE INFORMATION

CHEMISTRY OF INSECTICIDES AND FUNGICIDES. By *Donald E. H. Frear*. Published by D. Van Nostrand Co., New York, N. Y. 300 pages. Price $4.

Reviewed by *J. R. Callaham*

FOR MANY years there has been a great need for a reference book that would classify, evaluate and summarize our present-day knowledge on the chemistry of industrial insecticides and fungicides. Works have appeared which cover the subjects of applied entomology and plant pathology, but the present publication is the first of its kind devoted solely to the chemical aspects of this growing field.

This book is concerned primarily with the composition, properties and reactions of the various chemicals used or proposed for the control of insects and plant diseases. It is valuable for the research chemist and entomologist the biochemist, and the graduate student. The author deals with the purely chemical aspects of insecticides and fungicides thoroughly, and his coverage of the voluminous and scattered literature is selective as well as comprehensive. The brief historical review of each compound will prove of interest to many in the field.

Helpful as the book will undoubtedly prove to research chemists and entomologists, this reviewer believes that its usefulness would be greatly enlarged if industrial and economic aspects were given more stress. It is sometimes difficult, for instance, to judge the relative importance of some of the minor products discussed. More recent statistics than those used are often available. Nothing shows the economic importance and trend of a product more than tabular statistics on production or consumption and price ranges for a period of years. Such figures can be obtained without too much difficulty for the more common insecticides yet, for some reason, they are practically never given in publications.

Sales figure for calcium arsenate in 1941, which was 70,000,000 lb., will probably cause some authorities to disagree with the author's statement, "it appears that the use of calcium arsenate, in this country at least, is declining." It would seem that this large-tonnage insecticide would deserve more than the five pages devoted to it.

Usefulness of the work, in the opinion of this reviewer, could have been further increased by including more data in convenient tabular form, such as analyses or specifications of leading products now on the market, comparative physical constants, orders of toxicity to insects, toxicity to warm-blooded animals, etc. Also useful would have been more information on commercial and home methods of preparation, corrosive action, if any, on spray equipment, poisoning effects on soils, shipping containers and regulations. More stress, it is felt, could have been given to certain of the more promising recent developments and to the trend toward synthetic organic compounds in place of devoting some 70 pages to detailed analytical methods, taken mostly from the A.O.A.C. "Official and Tentative Methods of Analysis."

However, Frear has made a pioneer and worth-while contribution to the field of insecticides and fungicides and he is to be commended for the thoroughness with which he has reviewed the available literature on the subject. It is hoped that in future editions the author will include more data of a commercial and economic nature and hence extend the usefulness of the book from research chemists and entomologists to include dealers and manufacturers, industrial chemists, economists, salesmen and others concerned with industrial aspects of the field. To fulfill such an order is not easy, for it is almost axiomatic that concerns and individuals most avid to obtain and use such practical information are least cooperative in supplying the same. However, an excellent beginning has been made.

PIONEER CONTRIBUTION

INDUSTRIAL FURNACES, Vol. II. Second Edition. By *W. Trinks*. Published by John Wiley & Son, New York, N. Y. 351 pages. Price $5.00.

Reviewed by *William J. Shore*

PROFESSOR TRINKS has written a most competent book which should be of great interest to all industrial furnace men. A study of the material presented shows quite clearly and distinctly how modern economic forces are influencing the design of furnace equipment and the selection of fuels. It is interesting to note the trend towards the use of prepared fuels such as gas, oil and electricity, and the trend away from hand-fired coal installation, in spite of the fact that coal is the lowest cost heating medium. The present demand for higher quality of materials produced, coupled with the ease of applying these fuels in a simpler and more effective manner, are in part the reason for this change.

The chapter on labor saving devices is replete with an infinite variety of automatic continuous conveyor type furnace equipment. These new machines turn out quantity and quality products in small space and with a minimum amount of hand labor. Even though hand-fired coal applications are on the way out, Professor Trinks devotes considerable space to the use of pulverized coal as fuel for large continuous furnaces. Thus, the cycle completes itself—back to coal again—except that this time no hand labor is required.

It is apparent that the materials have been chosen with discrimination and with meticulous care. The many photographs, charts and tables are all highly informative and should be helpful. There are no involved and complicated mathematical formulas in this book, which fact should appeal to the practical furnace man. This book cannot be skimmed through or read in haste. If read leisurely and with close attention, it will fully repay the time devoted to it.

ATOMISTICS

THE "PARTICLES" OF MODERN PHYSICS. By *J. D. Stranathan.* Published by The Blakiston Company, Philadelphia, Pa. 571 pages. Price $4.

Reviewed by *Emy Henning Nachod*

A GOOD house is built out of many bricks, not only many in number but also manifold in regard to size and shape. The great building which we call Physics is also built out of many "bricks" differing in size, shape, weight and structure.

Dr. J. D. Stranathan of the University of Kansas has undertaken the difficult task to render an account of the state of knowledge of these different species of "bricks" in his "Particles of Modern Physics." The book is divided into 14 chapters which contain the following subject matter: gaseous ions, the electron, the electrical discharge, cathode rays, positive rays and isotopes, photons, X-rays, α-, β- and γ-rays, the positron, the neutron, atomic nuclei, cosmic rays, the mesotron, and particles or waves?

It is extremely enjoyable to read the book which is written in plain language. Many figures and illustrations help the reader in the pursuit of his studies. Pertinent literature is quoted at the foot of each page and represents a critical selection rather than a complete enumeration of papers. This however, is justified for the purpose of this treatise. The publishers have done their share regarding the printing and the binding.

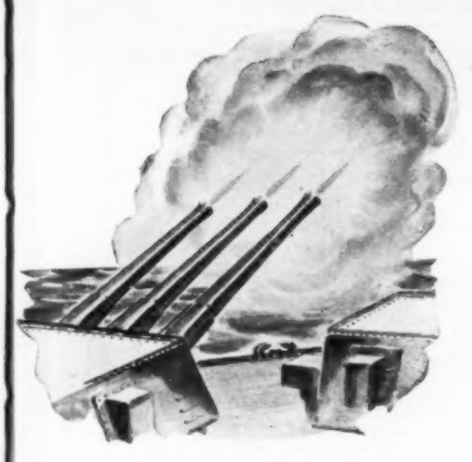
The book is wholeheartedly recommended to anybody who wishes to acquaint himself with atomistics and wants to keep abreast with the rapid development of the last decades.

COMPREHENSIVE REFERENCE

KEEPING LIVESTOCK HEALTHY. By staff of U. S. Department of Agriculture. Available from Superintendent of Documents, Washington, D. C. 1276 pages. Price $1.75.

THIS is a comprehensive reference volume intended to stimulate all divisions of agriculture toward better animal husbandry and animal supply for food, fiber, and byproducts. Various chapters are by specialists in the Department, presenting scientific information and recommendations regarding disease or pest control.

Any chemical engineer, research agency, or company, which deals with insecticides, pest control chemicals, or other materials for the animal industries of the country will find this volume a must item for its library and for regular use. Those having occasional interest in such chemicals or in the products of the animal industries as raw materials for further processing will do well to have it available. Many of the chapters are very readable and stimulating in addition to being useful to answer the occasional strange inquiry which the ordinary reference books do not cover.



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GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. In ordering publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, express order, coupons, or check. Do not send postage stamps. All publications are in paper cover unless otherwise specified. When no price is indicated, pamphlet is free and should be ordered from Bureau responsible for its issue.

Effects of Artificially Drying Seed Cotton on Certain Quality Elements of Cottonseed in Storage. Agriculture Department, Circular 651. Price, 5 cents.

The Wild Horse Quicksilver District, Lander County, Nevada, by Carle H. Dane and Clyde P. Ross. Geological Survey, Bulletin 931-K. Price, 25 cents.

Manganese Deposits in the Paymaster Mining District, Imperial County, California, by Jarvis B. Hadley. Geological Survey, Bulletin 931-S. Price, 30 cents.

Muscovite in the Spruce Pine District, North Carolina, by T. L. Kesler and J. C. Olson. Geological Survey, Bulletin 936-A. Price, 35 cents.

Electrodeposition of Manganese. No. 15 of Hydrometallurgical Studies of Manganese Ores, by David Schlain. Bureau of Mines, Report of Investigations 3651. Mimeographed.

Dimensional Changes of Floor Coverings with Changes in Relative Humidity and Temperature, by Percy A. Sigler, Robert I. Martens, and Elmer A. Koerner. Bureau of Standards, Report BMS85. Price, 10 cents.

Structural, Heat-Transfer, and Water-Permeability Properties of "Speedbrik" Wall Construction Sponsored by the General Shale Products Corporation, by Mahlon F. Peck, Vincent B. Phelan, Richard S. Dill, and Perry H. Petersen. Bureau of Standards, Report BMS86. Price, 15 cents.

A Method for Developing Specifications for Building Construction. Report of Subcommittee on Specifications of the Central Housing Committee on Research, Design, and Construction. Bureau of Standards, Report BMS87. Price, 10 cents.

Workers in Subjects Pertaining to Agriculture in Land-Grant Colleges and Experiment Stations, 1941-42. Department of Agriculture, Miscellaneous Publication 480. Price, 25 cents.

Soluble Material of Soils in Relation to their Classification and General Fertility. Department of Agriculture, Technical Bulletin 813. Price, 15 cents.

Soap Specifications. P-S-536a. Soap and Soap-Products; General Specifications (Methods for Sampling & Testing). Price, 10 cents.

Possible Substitutes for Nickel in the Present Five-Cent Coin, by C. Travis Anderson. No. 56 of Progress Reports—Metallurgical. Bureau of Mines, Report of Investigations 3658. Mimeographed.

Nickel-Copper Deposits on the West Coast of Chichagof Island, Alaska, by William T. Pecora. Geological Survey, Bulletin 936-I. Price, 20 cents.

Military Protective Construction (Passive Defense Measures Against Aerial Attack). War Department, Technical Manual 5-310. Price, 20 cents.

Latin American Trade. A Tariff Commission document issued in four volumes. Part I—Trade of Latin America With the World and With the United States. Price, 20 cents. Part II—Commercial Policies and Trade Relations of Individual Latin American Countries. Volume 1—The South American Republics. Price, 35 cents. Part II, Volume 2—Mexico and the Republics of Central America and the West Indies. Price, 40 cents. Part III—Selected Latin American Export Commodities. Price, 35 cents.

Home Insulation with Mineral Products—Conservation of Fuel for War, by Oliver Bowles. Bureau of Mines, Information Circular 7220. Mimeographed.

Fluorspar and Cryolite, by H. W. Davis. Bureau of Mines, Chapter (preprint) from Minerals Yearbook 1941. Price, 5 cents.

Vapor-Pressure Chart for Volatile Hydrocarbons, by R. Vincent Smith. Bureau of Mines, Information Circular 7215. Mimeographed.

Crude Oils of New Mexico, by E. C. Lane. Bureau of Mines, Report of Investigations 3660. Mimeographed.

Marketing Mineral Pigments, by Charles L. Harness. Bureau of Mines, Information Circular 7217. Mimeographed.

Marketing Strategic Mica, by Lawrence G. Houk. Bureau of Mines, Information Circular 7219. Mimeographed.

Size Consist, Chemical Analysis, and Physical Properties of 2½-Inch Subbituminous Slack from the Denver, Colo., Region, by V. F. Parry and W. S. Landers. Bureau of Mines, Report of Investigations 3655. Mimeographed.

Silver—Recovery Studies, by E. S. Leaver, J. A. Woolf, A. P. Towne. Bureau of Mines, Report of Investigations 3661. Mimeographed. Some factors affecting flotation of the silver-bearing minerals tennanite and enargite.

Hazards Due to Electric Shock Transmitted Across Discharge Spray of Compressed Carbon Dioxide, by R. L. Grant. Bureau of Mines, Report of Investigations 3656. Mimeographed.

Smelting of Manganese Oxide, Carbonate, or Silicate Ores with Copper and Iron Sulfides, by R. G. Knickerbocker and Virgil Miller. Bureau of Mines, Report of Investigations 3659. Mimeographed. No. 18 of Pyrometallurgical Studies of Manganese Ores.

Bibliography of United States Bureau of Mines Investigations on Coal and Its Products, 1910-35, by A. C. Fieldner, Alden H. Emery, and M. W. vonBernewitz. Bureau of Mines, Technical Paper 576. Price, 15 cents.

Carbonizing Properties and Petrographic Composition of Bakerstown-Bed Coal from No. 23 Mine, Coketon, Tucker County, W. Va., and the Effect of Blending this Coal with Pittsburgh-Bed (Warden Mine) Coal, by J. D. Davis, D. A. Reynolds, G. C. Sprunk and C. R. Holmes. Bureau of Mines, Technical Paper 644. Price, 15 cents.

Carbonizing Properties and Petrographic Composition of No. 2-Bed Coal from Bartoy Mine and No. 5-Bed Coal from Wilkeson-Miller Mine, Wilkeson, Pierce County, Washington, by J. D. Davis, D. A. Reynolds, G. C. Sprunk, C. R. Holmes and J. T. McCartney. Bureau of Mines, Technical Paper 649. Price, 10 cents.

United States Government Manual, Fall, 1942. Bureau of Public Inquiries of the Office of War Information. Price, $1.00.

Formulae for Completely and Specially Denatured Alcohol. Appendix to Regulations No. 3. Bureau of Internal Revenue. Price, 10 cents.

Report of the National Academy of Sciences, 1940-41. National Academy of Sciences. Price, 25 cents.

Effects of Artificially Drying Seed Cotton on Certain Quality Elements of Cottonseed in Storage, by Ralph A. Rusca and Francis L. Gerdes. Department of Agriculture, Circular No. 651. Price, 5 cents.

List of Publications and Patents of the Division of Insecticide Investigations. Bureau of Entomology, Department of Agriculture. Mimeographed.

Inspection and Control of Weights and Measures in the United States, by George W. Hervey and Reign S. Hadsell. Consumers' Counsel Division, Department of Agriculture. Price, 15 cents.

Mineral Wool; Loose, Granulated or Felted Form in Low-Temperature Installations. Proposed Commercial Standard TS-3341. Bureau of Standards. Mimeographed.

Supplementary Report on War Courses Offered by Collegiate Schools of Business and Departments of Economics. Bureau of Foreign and Domestic Commerce. Mimeographed.

Keeping Livestock Healthy. Department of Agriculture. Price, $1.75. Yearbook of Agriculture, 1942.

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Acid-Proof Cement. Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa. — Booklet 6 — 8-page folder dealing with this concern's "Penchlor" acid-proof cement. Discusses advantages of the product, its chemical and physical as well as electrical properties and method of applying, uses in various industries, and other data. Contains engineering data in table, diagrammatic drawings and text form.

Air Cleaner. Westinghouse Electric & Mfg. Co., Edgewater Park, Cleveland, Ohio — Bulletin B3083 — 6-page bulletin describing the use of "Precipitron" in war industry production. Describes ability of the unit to clean circulating air of 90 percent of all dirt and dust particles, operating principles and outstanding applications in various industries. Extensively illustrated.

Alloys. Tempil Corporation, 132 West 22nd St., New York, N. Y.—Wall chart which covers correct preheat temperatures and other pertinent data for 79 principal ferrous and non-ferrous alloys commonly used in industry. Includes information on approximate percentage composition of the various alloys recommended, preheats, and use of this concern's "Tempils" or "Tempilstiks."

Arc Welding. General Electric Co., Schenectady, N. Y.—Bulletin GEA2704B —32-page bulletin, profusely illustrated, dealing with arc-welding accessories put out by this concern and designed to make arc-welding safer and easier. The items specified and described include goggles, ventilated head protectors, flame-proofed welding screens, metal and carbon electrode holders, etc. Includes a price list.

Bearing Lubrication. SKF Industries, Inc., Front St. and Erie Ave., Philadelphia, Pa.—Form 266—28-page catalog designed to serve as a lubrication manual for ball and roller bearings put out by this concern. Discusses function of lubrication, recommended viscosities and oil supply systems, oil lubrication, grease lubrication, comparative advantages of oil and grease, high temperature applications, protection of idle machinery, cleaning, etc. Extensively illustrated by diagrammatic drawings and charts of engineering data.

Butadiene Storage. Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.—Research Bulletin 7381B—35-page booklet dealing with the storage of 1, 3 butadiene, with data developed by the Chemical Storage Fellowship at Mellon Institute of Industrial Research. Discusses variables which affect storage cost, recommendations for storage containers, cost data and computations, container types, corrosive effects on container materials, deterioration during storage, transportation, physical and chemical properties, and a brief discussion of methods of preparation. Contains extensive engineering data in charts, tables, diagrammatic drawings, and text. Well illustrated.

Butterfly Valves. R-S Products Corporation, Wayne Junction, Philadelphia, Pa.—Catalog 15-B—4-page booklet dealing with this concern's line of heavy-duty butterfly valves with sufficient face-to-face dimensions to permit mounting of ball bearings for high pressure service. Advantages, applications and general operating characteristics are discussed. Included are complete tables of dimensions with raised face or ring joint flanges. Illustrated.

Chemicals. A. R. Maas Chemical Co., 4570 Ardine St., South Gate, Calif. —36-page, vest-pocket size catalog of the line of chemicals put out by this concern. Includes data on a large number of phosphates, alums, sodium sulphites, hypo, etc. Includes formula, grade, analysis, shipping containers, and a description of the chemical together with its principal industrial uses. Includes a brief discussion of use of anhydrous sodium sulphite for removing oxygen from boiler feed water, phosphoric acid for softening boiler water, sodium sulphite in ore flotation and various chemicals in industrial photography.

Chromium Plating. United Chromium, Inc., 51 East 42nd St., New York, N. Y. —16-page booklet discussing how chromium plating saves materials and manhours in fabrication of metals. Divided into sections dealing with salvaging of parts and production tools, reducing corrosion on equipment, protecting precision of wearing parts, increasing output of metal working tools and fortifying accuracy of gaging tools. Also discloses how industrial chromium plating is made available in individual plants and through competent plating shops.

Coal Crushers. McNally Pittsburgh Mfg. Corp., 307 N. Michigan Ave., Chicago, Ill.—Bulletin 342—20-page booklet listing and describing briefly the various lines of coal crushers and breakers put out by this concern. Each unit is illustrated and discussed briefly. Includes data on dimensions and capacities.

Compressors. Clark Bros. Co., Inc., Olean, N. Y. — Form M35742—8-page booklet containing maintenance hints for this concern's "Angle" super 2-cycle gas engine driven compressors. Discusses what should be done daily, weekly, monthly, quarterly and yearly. Also contains charts to aid in quickly spotting trouble and data on ways and means to help reduce maintenance and repair costs. Illustrated.

Connections. Trabon Engineering Corp., Cleveland, Ohio—Bulletin 424— Two-page form illustrating and describing briefly this concern's new straight and angle swivels for use in making oil, grease, air and other line connections between stationary and revolving, oscillating or other moving surfaces.

Control Equipment. Automatic Temperature Control Co., Inc., 34 E. Logan St., Philadelphia, Pa.—Form B10—8-page folder dealing with this concern's Series 2800 automatic time controls. Discusses application, construction, types and operating features, ratings and accuracy. Each unit is illustrated and labelled in detail. Includes a number of arrangements in diagrammatic form. Extensively illustrated.

Control Instruments. The Foxboro Co., Foxboro, Mass.—Catalog 95A—48-page catalog in ten sections, listing the full line of instruments for measurement and control of industrial process conditions. Describes the instruments, accessories and supplies, valves, instrument panels and similar subjects. Contains over 200 illustrations.

Control Instruments. Wheelco Instruments Co., 825 W. Harrison St., Chicago, Ill.—6-page bulletin interpreting the recently amended WPB Conservation order L-34 as it applies to use of thermocouples and thermocouple protecting tubes for pyrometric instruments. Recommends thermocouples and tubes that will serve in place of materials prohibited by the order.

Conveyor Belting Conservation. Robins Conveying Belt Co., Passaic, N. J.— Wall chart giving engineering recommendations in condensed form for proper care and conservation of rubber conveyor belting.

Copper Conservation. Delta-Star Electric Co., 2400 Block Fulton St., Chicago, Ill. — Publication 4210 — 12-page booklet outlining a method of saving copper in industrial plant wiring. Discusses methods of reducing copper con-

sumption, cost comparisons, voltage calculations, determination of cable sizes, and other similar topics. Contains extensive engineering data in table and chart forms. Includes amendments concerning open wiring put out by the National Fire Protective Association.

Copying Machines. Photo Reproducing Equipment Co., Chatham, N. J.—4-page folder illustrating, describing briefly, and listing applications of this concern's "Tru-Copy-Phote" copying machines for layouts, maps, blueprints, etc. Includes specifications and prices.

Crane Truck. Baker-Raulang Co., Baker Industrial Truck Division, 2168 W. 25th St., Cleveland, Ohio—Bulletin 1612—4-page form dealing with the locomotive type crane truck of 10,000 lb. capacity put out by this concern. Gives specifications of the unit, and its applications, together with dimensional drawings and data on capacity. Illustrated.

Degreasers. Detroit Rex Products Co., 13005 Hillview Ave., Detroit, Mich. —Form 175—24-page booklet which illustrates and describes briefly the line of solvent degreasing machines and equipment put out by this concern, including the vapor, immersion, spray and vapor-spray-vapor types. Alkali, emulsion and spirit washers and "Triad" alkali cleaning and stripping compounds are also covered.

Dehydrating Equipment. Drying and Concentrating Co., 332 S. Michigan Blvd., Chicago, Ill. — 10-page booklet dealing with this concern's spray drying plant, suitable especially for dehydrating foods, chemicals and pharmaceutical products. Discusses operation, economy, simplicity of control and flexibility of the system. Contains numerous installation photographs and diagrammatic drawings.

Dust Recovery. Buell Engineering Co., Inc., 70 Pine Street, New York, N. Y.—28-page booklet entitled "Van Tongeren System of Industrial Dust Recovery." Discusses principles and practice of dust recovery, advantages of the Buell dust recovery system, principles of operation, technical aspects, uses in chemical and process industries, flue dust collection, etc. Extensively illustrated by halftones, diagrammatic drawings, and charts.

Electric Arc Etcher. George Gorton Machine Co., Racine, Wis.—Form 1635A —8-page bulletin which illustrates and describes briefly this concern's new "Spit-Fire" electric arc etcher for deep etching of hardened parts or goods in the finished state. Shows typical illustrations of the instrument, specifications, accessories, etc. Includes prices of the various units.

Electric Motors. General Electric Co., Schenectady, N. Y.—Form GEA9322—2-page form announcing this concern's new totally enclosed induction motor for use in magnesium dust, aluminum dust and other combustible metal dusts. The unit is illustrated and described briefly. Includes a cutaway view.

Electronic Equipment. The Detect-O-Ray Co., 216 North Clinton St., Chicago, Ill.—4-page folder announcing and describing this concern's type of new and improved electronic equipment for control and protection, called the "Detect-O-Ray." Illustrates and describes briefly the unit, its industrial uses, installation, and list prices.

Essential Oils. Magnus, Mabee & Reynard, Inc., 16 Desbrosses St., New York, N. Y. — 12-page pamphlet describing this concern's line of essential oils and related products grown and distilled in the United States. Mentions the use of the oil and products for which it is substituted.

Equipment. D. J. Murray Mfg. Co., Wausau, Wis.—No. C142—8-page booklet describing briefly this concern's cast iron series "Grid" unit heaters to take the place of units made with aluminum heating sections. Contains capacity tables on the six models, a typical hook-up diagram and dimension diagram, details of construction and numerous diagrammatic sketches.

Fatigue. American Bottlers of Carbonated Beverages, 1128 16th St. N.W., Washington, D. C.—8-page booklet entitled "Fatigue vs. Efficiency," which

deals with causes and prevention of industrial fatigue. Discusses use of soft drinks as a means of refreshment, with data on calory values.

Gas Cracking. Hevi-Duty Electric Co., Milwaukee, Wis.—Bulletin HO1042—2-page form describing briefly and illustrating this concern's heavy-duty gas cracking unit designed to produce a protective atmosphere for use during heat treatment of alloy and high carbon tool steels, particularly those containing molybdenum. Includes specifications and a cross-sectional drawing.

Heaters. Dravo Corporation, Machinery Division, 300 Penn Ave., Pittsburgh, Pa.—Bulletin 506—10-page bulletin describing this concern's direct-fired heaters with a tabulation of weights of steam plant compared with Dravo heaters, typical installation in ordnance plant and comparison of various heating systems. Also gives general comparisons of materials weight, fuel savings, etc. Each unit is illustrated.

Heat Exchangers. The Griscom-Russell Co., 285 Madison Ave., New York, N. Y.—Bulletin 1621—12-page bulletin dealing with this concern's "G-R Tube-flo" sections designed as a heat exchanger in which tarry or dirty fluids are heated or cooled. Outlines distinctive features, and includes a concise tabular comparison between its design and those of shell-and-tube exchangers. Describes physical applications such as handling heavy crude oil, clay bearing oil, molten salt and liquids at extreme pressures and temperatures. Illustrated.

High Pressure Piping. Clark Bros. Co., Inc., Olean, N. Y.—Project No. 49—66-page, spiral-bound notebook entitled "High Pressure Pipeline Research". Gives a mathematical approach to high pressure, light-weight, high-speed equipment for pressure piping. Deals with the gas flow equation, design for minimum yearly transportation cost, design for minimum initial investment, economics of pipeline design for transporting gases in quantities other than that of optimum, derivation of the flow equation, and other topics. Well illustrated with charts, photographs and diagrammatic drawings. Contains extensive and valuable mathematical and engineering data.

Insulating Brick. Illinois Clay Products Co., Joliet, Ill.—2-page sheet describing briefly and illustrating this concern's "Therm-O-Flake" insulating brick. Includes characteristics, advantages, shipping information and uses.

Lift Trucks. Towmotor Co., 1226 E. 152nd St., Cleveland, Ohio—Form 37—36-page catalog entitled "The Inside Story of Towmotor". Describes briefly design of this lift-truck, comparison with other types, frame construction in detail, power plant and travel mechanism, lifting and stacking mechanism operating and control mechanism, and servicing and maintenance features Profusely illustrated.

Lubricating Oils. National Graphite Co., Inc., 17 John St., New York, N. Y.—one-page sheet describing briefly the properties, uses, and advantages of this concern's "Konag" transparent cutting oil for use on tough, tool-resistant steels and water soluble castor oil jelly for better lubrication at cutting edge. Includes prices.

Machinery Lubrication. Standard Oil Co., Sales Technical Service Department, Chicago, Ill.—Form P82—50-page booklet entitled "Pulp and Paper Mill Machinery and its Lubrication". Discusses the various processes in the manufacture of pulp, paper and lubricating appliances used for the machinery. Includes a description of recommended lubricants, cost records, etc. Contains extensive engineering information in text, photographic and diagrammatic drawing forms.

Magnetic Separation. Magnetic Engineering & Mfg. Co., Clifton, N. J.—Bulletin 602—4-page folder which illustrates and describes briefly this concern's line of high power complete magnetic pulley type separators of standard and special design. Each unit is illustrated. Also includes data on weights, capacities, dimensions.

Manometers. Simplex Valve & Meter Co., 68th and Upland Sts., Phila-

delphia, Pa.—Bulletin 200—8-page bulletin describing the various lines of manometers put out by this concern. Each unit is illustrated and described briefly. Includes data on specifications and cross-sectional drawings.

Materials Handling. Reading Chain & Block Corporation, 2100 Adams St., Reading, Pa.—12-page booklet describing briefly and illustrating this concern's line of electric hoists and chain hoists. Discusses the unit construction plan, details of hoisting mechanism, details of motor units and gives specifications and general hoist details.

Materials of Construction. The United States Stoneware Co., 60 East 42nd St., New York, N. Y.—Bulletin 1620—16-page bulletin giving technical and engineering data on "Tygon" synthetic rubber-like material as a corrosion-resistant material and as a material of construction for other purposes. Describes briefly the "Tygons", their chemical resistivity, physical characteristics, specific applications, use for insulation and tubing, fabric impregnation, etc. Discusses briefly applications for high temperatures, pipe coatings, valve diaphragms, gaskets, etc.

Metal Cleaning. Detroit Rex Products Co., 13005 Hillview Ave., Detroit, Mich.—Form 174—24-page booklet dealing with this concern's various types of washers manufactured for use with alkali cleaning compounds, petroleum, and emulsion cleaners for use on metals and metal parts. Includes features of design, construction of the machines, adaptations of machinery for defense production. Includes data on alkali cleaning and stripping compounds supplied and used in conjunction with this equipment.

Motor Maintenance. Allis-Chalmers Mfg. Co., Milwaukee, Wis. — Form B6052C—12-page booklet giving essential facts for quickly choosing correct motors for wartime application. Contains data in compact, simplified charts, accompanied by dimensional drawings. Includes construction features of the concern's "Lo-Maintenance" motors. Dimension ratings and prices are included.

Motor Maintenance. Century Electric Co., 1806 Pine St., St. Louis, Mo.—Notebook inserts dealing with the installation, care and adjustment of repulsion start, induction single-phase motors, fractional horsepower capacitor single-phase motors, split phase motors and other types. Gives concise and practical data on what to do if the motor fails to start, if operation is not satisfactory, suggestions for prolonging the life of the motor, elimination of noisy operation, excessive sparking, etc. Illustrated.

Motor Maintenance. General Electric Co., Schenectady, N. Y.—Bulletin GED1017 — 36-page bulletin dealing with motor fitness and discussing how to get the most service out of old and new motors, switching motors from one job to another, and equipping old machines with new motors. Also includes information on selection and application of motors, various types of motor enclosures, how to save critical motor materials, etc. Intended primarily for plants converted to war production. Contains useful engineering information in text, drawing, table, and chart form.

Mounted Wheels. Chicago Wheel & Mfg. Co., 1101 W. Monroe St., Chicago, Ill. — Bulletin F980 — 64-page booklet on the use of mounted wheels and accessories for portable tools. Discusses and illustrates a wide variety of portable tool accessories including miniature steel cutters, polishing wheels, sanding drums, disks, etc. Includes data on dimensions, price lists, specifications.

Oil Circuit Breakers. Roller-Smith Co., Bethlehem, Pa.—Catalog 3350—12-page catalog dealing with this concern's line of 15,000 volt oil circuit breakers for indoor service. Lists the various sizes of breakers with their interrupting ratings, closing and tripping currents, amount of oil required and approximate shipping weights. Control diagrams, methods of tripping and dimensional data also are given. Illustrated.

CHEM & MET ECONOMICS & MARKETS

PRODUCTION OF CHEMICALS CONTINUES TO RISE AS INDUSTRIAL OUTPUTS ARE INCREASED

MEASURED by the index of the Federal Reserve Board, production of chemicals has been steadily expanding in harmony with the larger industrial outputs. The unadjusted index for chemicals for September is 174 which shows a rise of four points over the August figure and is the highest yet recorded. The combined index of the Board—including all manufacturers and minerals—is preliminarily placed at 185, on adjusted basis. This compares with 183 for August. Of the August total, 98 points were ascribed to production of war goods and 85 points to civilian goods. The percentage of total production credited to war goods has been rising steadily and now is larger than that reported for civilian goods.

A clearer understanding of the growth in war-goods production may be obtained by referring to the index of munitions productions as compiled

Chem. & Met. Index for Industrial Consumption of Chemicals

	August	September
Fertilizers	38.75	38.00
Pulp and paper	18.70	19.06
Petroleum refining	14.88	14.70
Glass	15.76	15.30
Paint and varnish	13.60	13.97
Iron and steel	13.39	12.99
Rayon	15.17	14.89
Textiles	11.64	12.00
Coal products	9.58	9.39
Leather	4.67	4.70
Industrial explosives	6.08	6.21
Rubber	3.00	3.00
Lastics	4.30	4.45
	169.52	168.66

by the War Production Board. For this index, November 1941 equals 100 and from that month forward the number has jumped until the preliminary report for September places it at 381. The computation of this index includes planes, ships, tanks, guns and ammunition, and all campaign equipment. It does not include construction of military posts, airfields, depots and the like, wartime housing, or industrial facilities created for munitions production. The rise from 100 to 381 in so short a time explains not only the transition of industry to wartime purposes but also accounts for the sharp increase in chemical production as reported by the index of the Federal Reserve Board.

The *Chem. & Met.* index for chemical consumption has followed the general movement only up to a certain point. The regular consuming lines naturally were affected when demand for all kinds of finished products became abnormal. The peak was reached, however, early in the year and since then the index has fallen to a point where it seems to be destined to move along from month to month on a fairly even keel. The index for September is 168.66 which compares with 169.52 for August. Last year the indexes were 164.58 and 162.60 for August and September respectively. This indicates that there has been no material change in the 12-month period. Fertilizer, glass container, steel, rayon, and textiles have used larger amounts of chemicals this year but pulp and paper outputs have been declining in recent months and production has now been controlled so that no return to the rates maintained earlier in the year will be possible. Data for consumption of rubber are withheld and our estimate is purely arbitrary.

Soap makers have had an active call for their products this year but deliveries have fallen short of the record totals of a year ago. For the first nine months deliveries of hard soaps totaled 2,242,732,929 lb. as against 2,513,420,981 lb. for the comparable period of 1941. Deliveries of liquid soap for the same months were 539,792 gal. and 670,998 gal. respectively.

Late in October the chemical industry was given for the first time the pattern by which WPB's Chemical Branch is granting requests for non-military chemicals allocations. The allocations are made on the basis of end use rather than priority rating and the summary shows which requests for October supplies were granted in full, in part or were denied. While the program will change from month to month, the pattern will serve as a guide "to the areas in which chemicals are most likely to be available."

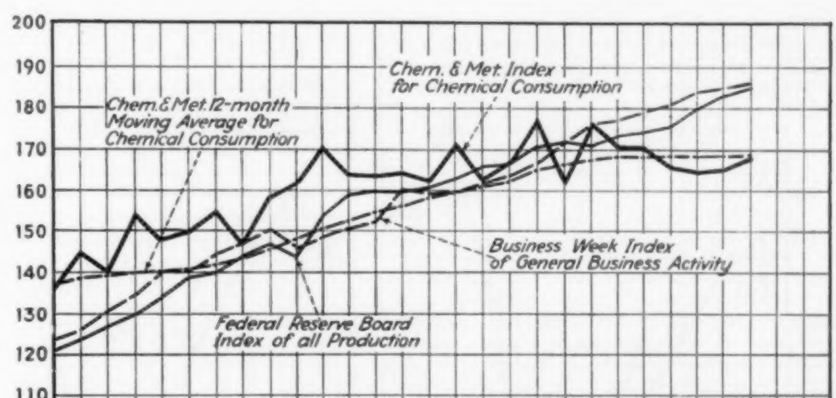
The October allocations were not just pulled out of the hat. The preliminary work was started months ago when the first forecasts of the supply situation for this particular month were made. The forecast for October was made on the basis of the productive capacity at that time plus the new production that would come in before October. On the other side of the book was the requirements for military uses, so that simple subtracting provided the amounts available for non-military uses. It is planned to adjust the figures from month to month as the various requirements change and in accordance with progress in construction of new facilities and any other factors that might affect the supply picture.

Greatest potential margin for error is in the construction of new plants. If the construction comes in late the whole picture is thrown out of focus. For that reason the greatest effort is made to see that new facilities begin to produce when scheduled to start, sooner if possible.

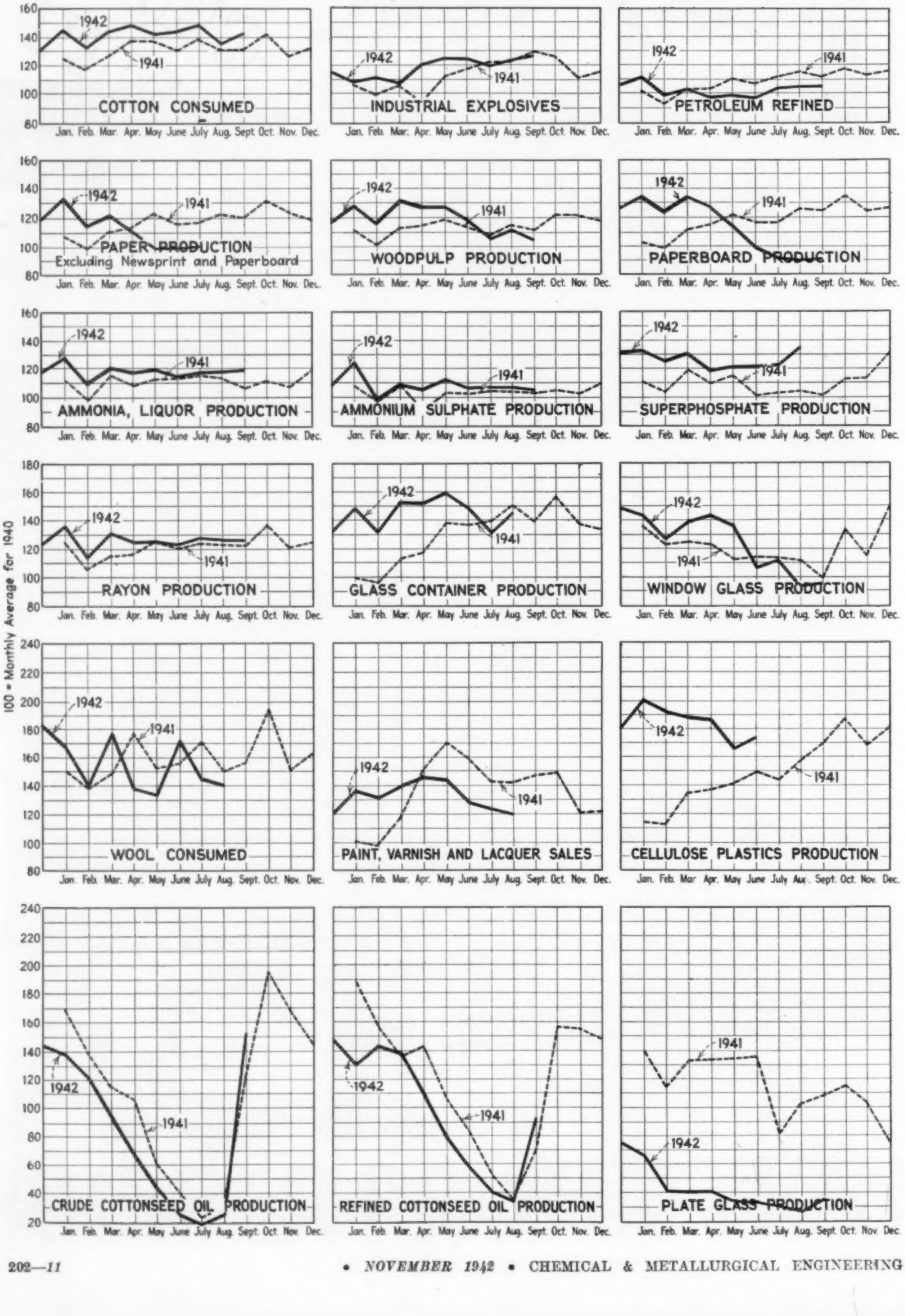
The Chemical Branch has explained that the allocation requests do not indicate actual requirements for a given material in most instances. The industry has reduced its requests in the fields where known shortages exist.

During the month acetic anhydride was placed under the system of allocations by means of General Preference Order M-243. An amendment to order M-157 accomplished the same purpose in respect to chemical cotton pulp. Both of these orders provide a means by which the administrators of the orders are notified of deliveries to the armed services so that the "books" can be kept in balance.

During the month WPB also revoked order M-147 to bring cashew nuts under the terms of the general import order M-63. And the Board of Economic Warfare announced that corn oil, cottonseed oil, sunflower seed oil, and peanut oil had been added to the list of fats and oils that CCC will purchase under the same order.



Production and Consumption Trends

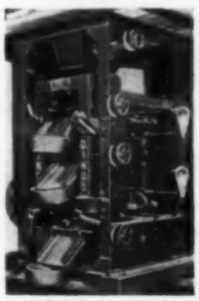


Dings MAGNETIC SEPARATION HIGH INTENSITY THE MAGNET Dings MAGNETIC SEPARATION HIGH INTENSITY

Published by DINGS MAGNETIC SEPARATOR CO., 505 Smith St., Milwaukee, Wis.

REMOVING ILMENITE FROM ZIRCON

Reducing 1¾ to 2½% of feebly magnetic ilmenite to a negligible quantity in zircon is the tough job being accomplished in a large plant by the Dings Type I.R. Magnetic Separator illustrated. This machine is also used for reducing .002% by weight of metallic iron in tin oxide to .0006% by weight.



The Dings Type I.R. Separator is the most powerful type of separator built and will accomplish separations that were impossible before this type of machine was developed. It consists of a series of rotating rolls, one above the other magnetically induced by huge and powerful coils. Separation takes place in successive stages, each roll deflecting some of the magnetic particles from their normal course. The machine can be built with as many rolls as necessary to accomplish the desired separation.

Diagrams and complete details on the operating principle, construction and uses of this machine are given in Catalog 770. This catalog also describes other *Super High Intensity* Dings Separators for difficult separations of minute amounts of feebly magnetic materials. Send a postcard to Dings asking for Catalog 770.

FREE MAGAZINE

A postcard request to Dings will put your name on the complimentary mailing list of THE MAGNET, a colorful, interesting publication containing unusual, technical and humorous stories of magnetism.

DUST EXPLOSIONS TAKE TREMENDOUS ANNUAL TOLL

Vital War Plants In Danger

Millions of dollars are lost in hundreds and hundreds of dust explosions and fires in feed and flour mills, grain elevators, starch, sulphur, rubber, lacquer, fertilizer, cork, sugar, rosin plants and many other types of mills where fine dust is existent. The extent of these losses is almost unbelievable, only the larger disasters receiving public notice. The causes vary, but one of the most frequent sources of such fires is tramp iron, a fact that has been well established by insurance companies, mill owners and others concerned. Tramp iron, passing through an attrition mill, down chutes or other places where a metal to metal contact is established frequently causes sparks that in a dust laden atmosphere cause instantaneous explosions. In some instances it has even been indicated that tramp iron passing through a grinder becomes hot enough, due to friction, to cause a fire.

When the grain elevator shown in the accompanying illustration was destroyed, the owners built a new one and protected it with Dings Rectangular Magnets. As much as 25 lbs. of iron per day is being extracted from grain at the new plant—iron in the form of nuts, bolts, wire, tools, snuff cans, broken pieces of machinery and other odds and ends of junk.

PORTABLE SEPARATOR FINDS MANY USES

Compact and light in weight, this pulley type separator is completely portable and can be moved around shop easily from job to job. Inclined design makes it easy to shovel material onto endless belt at one end. Discharge, set at any desired height, may deliver material to bins, trucks or any available receptacle.

This machine can be used in practically all industries for removing iron from all types of material. Head drive pulley is a Dings High Intensity air-cooled electro-magnetic pulley with bronze coil covers. These units are engineered to meet individual requirements and can be supplied for handling any material that can be separated effectively with a magnetic pulley.

GET IN THE SCRAP—NOW!

Striking view in smelting department of large plant using Dings Separators.

The Bureau of Industrial Conservation of the War Production Board urges manufacturers to "Get in the Scrap," to find ways and means of salvaging ferrous and non-ferrous metals, rubber, textiles and many other miscellaneous materials.

Many plants are finding magnetic separators an indispensable part of this job. Reclaiming iron from the waste pile, from foundry sand, from slag . . . taking iron out of reclaimed non-metallics . . . separating ferrous and non-ferrous scrap . . . concentrating ore . . . handling scrap and other metal . . . protecting crushers, grinders and other vital machinery from tramp iron damage . . . these are a few of the jobs magnetic equipment can do better and faster and cheaper. For equipment to handle your work call on Dings.

Concentrating Flue Dust

Recent experimental work indicates the possible use of Dings Crockett Separators for concentration of flue dusts from blast furnaces. This would result in less dilution of the charge when flue dust containing iron is collected and introduced back into the furnace.

Laboratory tests, using a Dings-Davis Tube Separator which gives small scale results comparable to a commercial Crockett machine, showed excellent results. Crockett Separators are built only by Dings.

TRADING IN CHEMICALS STIMULATED BY EXTENSION OF PRICES TO COVER 1943 DELIVERIES

Although distribution of many chemicals is under control, the contract season has stirred up considerable interest in 1943 deliveries and contract business is reported to have been fairly active and diversified. For the most part, prices likewise are under control—either official or voluntary—and the new contract figures are merely an extension of the values previously in effect.

Official action still is important as a price factor. For instance, last month revisions were made in the maximum prices for fermentation acetone, normal fermentation butyl alcohol, and normal fermentation butyl acetate. The revised figures for acetone in the eastern territory are 7c a lb. delivered in tank cars; 8½c a lb. in drum car lots; and 9c a lb. in drums less than car lots. Furfural has been freed from price control when sold or delivered for use in the manufacture of synthetic rubber. Producers of high wines may establish ceiling prices for sales to the Defense Supplies Corp. at cost of production plus 2c. a gal.

Most important developments affecting distribution of chemicals likewise were found in government regulations. Because of an acute shortage and increased demand for military uses, paraphenyl-phenol resins on Oct. 27 were put under complete allocation and use control by General Preference Order M-254. The resins covered by this order include the Bakelite Corporation's BR-254, BK-3962X, and BR-17,000; and the Reichold Chemical Company's Super-Beckacite 3000.

Amendment to the silica gel allocation order M-219 provides for small-order exemption, consumers of 125 pounds or less in any one month being exempt from terms of the order. The amendment also exempts finished products or sub-assemblies containing silica gel incorporated therein.

Conservation order M-157, covering the allocation of chemical cotton pulp, has been amended as of Oct. 20. The rewritten order follows the new pattern of chemical allocation orders and makes it plain that each person authorized to accept delivery of chemical cotton pulp must use it only for the purpose authorized unless otherwise specifically directed by WPB. Military exemptions from the restrictions on pulp deliveries have been eliminated in the amended order. The Army and Navy must now apply for specific authorization to accept deliveries, so that their requirements will be made known to the administrators of the order. The standard chemical application form PD-600 has been substituted for the previous consumer's form PD-507. Specific directions are given for filling out PD-600. Primary product must be specified in terms of viscose products, cellulose acetate products, ethyl cellulose. Specific product uses in terms of consumer products are also required.

General Preference Order M-152 on arsenic has been amended as of Oct. 21, superseding the original allocation order of May 22, 1942. Tightening control over the use of arsenic, the amended order provides that after Nov. 1 no one may use any arsenic, regardless of when acquired, except as authorized by WPB. On and after Jan. 1, 1943, deliveries and acceptances thereof are subject to specific WPB authorization. Small order exemptions are provided up to 650 pounds per quarter, for use in medicinal, research, testing, analytical and educational work. Uses of arsenicals as medicines are exempt. The standard chemical forms PD-600 and 601 will be used.

General Preference Order M-243 places acetic anhydride under complete allocation control, effective Nov. 1. If possible the order states that WPB will issue authorizations with respect to deliveries at the commencement of such month but may at any time issue directions with respect to deliveries or with respect to uses. The order provides that each person authorized to accept delivery of acetic anhydride must use the material for the purpose authorized and only for such purpose. Users must apply for allocations on form PD-600 by the 15th of the preceding month. In the case of November deliveries, this should be done immediately. Permissible end uses listed in the order include only aspirin, synthetic vitamins, other pharmaceuticals, explosives, cellulose acetate, cellulose acetate butyrate, cellulose acetate propionate, and synthetic fiber (also resale). Further breakdown into "ultimate uses" is requested. Producers must report on form PD-601, listing customers by preference rating groups.

Suppl. Order M-154-a, the allocation order which restricted the use of polyvinyl butyral to war orders only has been revoked, effective Nov. 1. Provisions of this order are incorporated into a revised polyvinyl chloride order which has been renamed Vinyl Polymers. The amended M-10 order is little changed from the previous form. Vinyl

CHEM. & MET. Weight Index of CHEMICAL PRICES

Base=100 for 1937

This month	**108.94**
Last month	109.30
November, 1941	103.89
November, 1940	99.53

In many cases contract business is going through covering early 1943 deliveries. Prices quoted are practically unchanged from those which were in effect for the final quarter of this year. Prices in general show hardly any change with the more important chemicals under ceilings.

polymers includes plasticized or unplasticized polymers and copolymers of vinyl acetate, vinyl chloride and polyvinyl alcohol, and their condensation products. Scrap is also included. Reports will continue to be made on forms PD-36 (users) and PD-33 (producers) as before.

Amendment 2 of the chlorinated hydrocarbon solvents order M-41 restores the provision of the order which permits users of carbon tetrachloride for purposes assigned a B-2 rating to consume 100 percent of the amount used in the base period. The 100 percent provision which was in effect from Aug. 1 to Sept. 30 is now restored until Dec. 31. B-2 ratings authorize delivery of carbon tetrachloride for degreasing machines, packaged cleaning preparations, cleaning electrical equipment and for dry cleaning establishments. Base period includes the year ending Sept. 30, 1941.

Amendment of orders M-57, M-238 and M-77 provides that after Nov. 1 specific authorization by the director general for operations will be required for the use of tung, oiticica and rapeseed oil, except for the users of 35 pounds or less per month. The standard chemical forms PD-600 and PD-601 are provided for requests for allocations for all three oils and for reports from distributors.

To provide adequate supplies of steatite talc for military used and prevent its dissipation into uses for which suitable substitutes are available, Conservation Order M-239 has been issued by the Director General for Operations. Until Nov. 15, 1942, manufacturers using steatite talc for non-permitted uses may use 50 percent of the amount of their average 1941 monthly consumption for such uses, though such manufacture or process must be completed by November 15, 1942. After that date no steatite talc may be used except for: insulators in communications, radio, radar, and underwater sound instruments; spark plugs for certain war agencies, or for delivery in accordance with L-158; filtering of foods, flavoring extracts, and medicines; medicines and health supplies, but not including talcum powder or cosmetics.

CHEM. & MET.
Weighted Index of Prices for
OILS & FATS

Base=100 for 1937

This month	140.27
Last month	140.85
November, 1941	130.26
November, 1940	68.79

With maximum prices established for the large tonnage oils, prices are largely stabilized with only minor fluctuations to be expected. Prices likewise are affected by the greater controls over distribution as this tends to cut down trading in the open market. Paint-making oils have been in smaller demand.

CHEMICALS BRANCH, WPB, REPORTS ON ALLOCATION OF CHEMICALS FOR OTHER THAN MILITARY USES

IN ORDER to provide industry with a pattern which might serve as a guide to the fields in which chemicals are most likely to be available, the Chemicals Branch of the War Production Board has issued a report showing in detail how requests for deliveries of chemicals were handled in the month of October. It was explained that allocations are made on a basis of specific end use rather than on priority ratings. The report shows how allocations were granted in full, granted in part, or denied. While the program may change from month to month, the procedure followed in October may be taken as an indication of how allocations may be made for the near future.

The chemicals specifically mentioned in the report together with their allocations follow:

Acid Naphthenic and Naphthanates

Granted in Full—
Rubber plasticizers and softeners
Rotogravure printing
Metal cleaning compounds
Lubricating greases and oils
Non-substitutable paint driers
Pigment manufacture processing
Granted in Part—
Semi-important paint driers
50 percent or less
Textile finishing
50 percent or less
Rust inhibiting compounds
50 percent or less
Denied—
All non-essential protective coatings

Alcohol, Capryl

Granted in Full—
Manufacture of dicapryl phthalate
Oil additives
Experimentation
Urea-formaldehyde resins, A-10 or higher
Granted in Part—
Can-lining—10 percent
Denied—
Alkyd resin manufacture
Urea-formaldehyde resins, lower than A-10

Ammonia, Anhydrous

Granted in Full—
Activated carbon
Amines
Ammonium sulphate
Ceramics
Corrosion control
Detinning
Dry cell batteries
Dye intermediates and dyestuffs and pigments
Fermentation
Films and photo chemicals
Fire retarding salts
Flour manufacture and baking
Flux, magnesium castings, other
Food processing
Glass
Heat treating salts
Hexamethylenetetramine
Inorganic nitrates
Insecticides
Laundries
Meat curing
Metal treating and nitriding
Molybdenum
Nitrocellulose
Nitro-organics
Nitrous oxide
Paper
Petroleum refining
Pharmaceutical
Photo-engraving
Plastics
Rayon manufacture
Refrigeration
Rubber
Soda ash
Tanners bate and tanning
Textiles
Water treatment
Welding
Granted in Part—
Nitrocellulose (q.v.)
Sulphuric acid adjusted to effect a gradual shift to sodium nitrate in specific types of operating where equipment permits
Denied—
Fertilizer
Caramel coloring
Household ammonia
Other cleaning purposes

Ammonia, Aqua

Granted in Full—
Ammonium picrate
Ammonium sulphide
Aniline
Caustic soda
Corrosion control
Copper extraction
Detinning
Granted in Full—
Dye intermediates
Electrolytic manganese
Explosives (industrial)
Fermentation
Frosting bulbs
Hexamethylenetetramine
Insulation
Laboratory reagents and pharmaceuticals
Metal refining
Mildew proofing
Molybdenum
Paper
Petroleum refining
Plastics and resins
Pyridine recovery
Rayon manufacture
Slime control
Soda ash, potash salts
Textile treatment
Tungsten wire
Water purification and refrigeration
Denied—
Fertilizer
Caramel coloring
Household ammonia
Other cleaning purposes
Chamber process sulphuric acid

Ammonium Sulphate

Granted in Full—
Alcohol
Ammonium alum
Ammonium nitrate
Biologicals and pharmaceuticals

Caramel coloring
Cellulose
Chromium oxide
Dyes
Fire retarding
Gas purifying
Insulation
Leather
Rayon staple
Slag cement
Woolen industry
Yeast

Granted in Part—
Fertilizer on basis of over-all nitrogen quota as established by U. S. Department of Agriculture

Aromatic Petroleum Products

Granted in Full—
Reagents
Hospital and industrial laboratory work
Dyestuffs
Essential medicinal preparations
Rubber preservative compound
Engine and fuel testing
Wool scouring
Rotogravure printing
Sanitary lacquers
Tub oil processing

Granted in Part—
Textile finishing (50 percent or less according to type of use)
Defense housing paints (50 percent on over-all basis)
Soap (50 percent on over-all basis)

Denied—
Furniture and cabinet finishing
Industrial lacquers
Industrial synthetic uses
Non-essential paints
Civilian degreasing

Arsenic

Granted in Full—
Standard Agricultural insecticides[1]

[1] Allocation was equal to each manufacturer's consumption in fourth quarter of 1942.

Metallurgical uses
Gas purification
Pharmaceuticals, except cacodylates
Hide cleaner and preservative

Granted in Part—
Cacodylates (50 percent)

Denied—
Weed killer[2]

[2] Hawaii allowed same amount as fourth quarter 1941.

Wood preservative, for other than Army and Navy contracts

Benzol

Granted in Full—
Manufacture of phenol
Manufacture of cumene
Manufacture of aniline
Manufacture of diphenyl
Manufacture of styrene
Manufacture of Denaturants

Granted in Part—
Dyes and intermediates (80 per cent)
Solvents for paint and lacquer thinners (40 percent)

Denied—
Paint and varnish remover
Dry-cleaning compounds
Type wash and similar uses

Calcium Hypochlorite, High-test

Granted in Full—
Sugar refining
Petroleum production and refining
Non-substitutable essential civilian uses, principally for water purification

Denied—
Uses for which sodium hypochloride or chloride of lime could be substituted

Chlorate Chemicals

Sodium Chlorate:
For weedkilling, allocated according to recommendations of the Department of Agriculture

Potassium chlorate:
Match industry cut to 90 percent of 1940–41 consumption

Perchloric Acid:
All requests, chiefly for metallurgical analysis, filled in full

Naphthalene

Granted in Full—
Phthalic anhydride
Beta naphthol
Other dye intermediates
Chlorinated naphthalene
Chemical compounds

Granted in Part—
Moth prevention and insecticide (75 percent)

Nitrocellulose

Granted in Full—
Cellophane lacquer
Shoe manufacturer cement and fabric coating
Printing inks (quick drying)
Industrial belting cement
Medical and hospital supplies
Surgical tape
Plastic containers
Food packaging and casings
Bookbinding

Granted in Part—
Luggage
Upholstery
Household and nursery articles
Window shade cloth
Industrial lacquer
Miscellaneous nondescript items

Denied—
Class III plastics under Order M-154

Oil, Sperm

Granted in Full—
Tool cutting oil
Ocenol
Essential duplicating carbon
Essential instrument lubricants
Essential textile processing oils
Heavy duty motor oil additives
Extreme pressure lubricant additives

Denied—
Leather tanning

Phenol

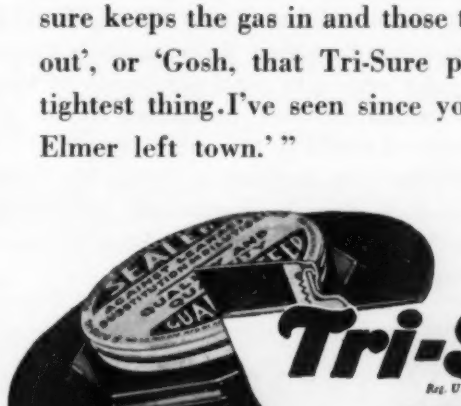
Granted in Full—
Plastics, AA
Medicinals (other than salicylates) A9 and higher
Chlorinated phenols A-l-k and higher
Disinfectant compounds, A-9 and higher

Granted in Full—
Dyestuffs, A-9 and higher
Chemical manufacturing, A-9 and higher
Solvent refining
Oil additives, for public transportation
Triphenyl phosphate—diphenyl phthalate ore flotation

"This is the first time he's stopped talking about those Tri-Sure Closures!"

"YOU remember how he used to worry about the weather all the time? Afraid it was going to rain—and seep into those drums of his? He said those old-fashioned plugs were more expensive than fur coats—because they ruined thousands of dollars worth of gasoline.

Now, since he put Tri-Sure Closures on his drums, he never talks about the weather—or yells 'pilferage,' 'contamination' and 'sabotage' in his sleep. He just smiles and says, 'Boy, that Tri-Sure seal sure keeps the gas in and those tough guys out', or 'Gosh, that Tri-Sure plug is the tightest thing. I've seen since your Cousin Elmer left town.' "



Tri-Sure
Reg. U S Pat. Off
CLOSURES

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK

Granted in Part—
- Plastics, A-1-a to A-1-k (60 percent)

Salicylates (60 percent average 1941 consumption)
- Medicinals (other than salicylates) A-10 (50 percent)
- Disinfectant compounds, A-10 (50 percent)
- Dyestuffs, A-10 (50 percent)

Denied—
- Plastics, lower than A-1-K
- Medicinals (other than salicylates), lower than A-10
- Dyestuffs, lower than A-10
- Disinfectants, lower than A-10

Phosphate Plasticizers—Tricresyl

Granted in Part—
- Oil additives (50 percent)
- Miscellaneous (25 percent over all basis)

Denied—
- Lacquers
- Adhesives
- Coatings

Denied—
- Synthetic rubber (substitute material available)

Triphenyl

Granted in Full—
- Film uses

Denied—
- Plastics
- Synthetic rubber
- Lacquers

Phthalic Anhydride

Granted in Full—
- Food and drugs
- Rubber chemicals
- Demulsifying agent oil additives
- Dyes and intermediates
- Resins, A-1-k and/or higher

Granted in Part—
- Resins, A-2 through A-10 (50 percent)
- Phthalic plasticizers (q.v.)

Shellac

Granted in Full—
- Ship paints
- Bonded mica
- Pattern finishes
- Mirrors
- Frames

Granted in Part—
- Phonograph records (15 percent of October 1941 consumption)

Denied—
- Coating finishes
- Floor emulsions and finishes
- Finishes for hats
- Aniline inks
- Furniture finishes

Sodium Nitrate

Granted in Full—
- Chemical salts, chemical manufacture
- Enamels and ceramics
- Explosives, industrial
- Food preserving
- Glass
- Heat transfer and heat treating
- Metallurgy
- Nitric acid, industrial
- Pigments, dyes
- Potassium nitrate
- Sulphuric acid

Granted in Part—
- Fertilizer on basis of over-all nitrogen quota as established by U. S. Department of Agriculture

Toluene—1 Toluene

Granted in Full—
- Medicinals

Granted in Part—
- Dyes and intermediates (50 percent of 1941 consumption)

Denied—
- All other chemicals

—2 Toluene

Granted in Full—
- Electric equipment

Granted in Part—

Protective coatings	(19 percent)
Dyes and intermediates	(55 percent)
Petroleum additives	(40 percent)
Cleaning	(63 percent)
Solvents	(13 percent)
Rubber accelerators	(57 percent)
Food preservatives	(80 percent)
Medicinals	(71 percent)
Other chemicals	(89 percent)

- Laboratory and research (88 percent)

Denied—
- Solvents (using LG#2)
- Adhesives

Vinyl Chloride, Polymers and Co-Polymers

Granted in Full—
- Substitute for rubber cable and wire insulation for essential industrial use
- Chemical resistant protective coatings
- Sheetings for hospitals and mortuaries
- Essential hospital supplies
- Dentures

Denied—
- S. N. Code wire in open knob tube, or cleat wiring
- Name plates
- Instruction plates
- Dials
- Belts, suspenders
- Wallets and tobacco pouches
- Uniform hat covers
- Dish covers
- Identification tag cord
- Civilian waterproof coating
- Stiffening agent for collars
- Mending tape
- Civilian watch crystals
- Bookbindings
- Shampoo capes
- Combs
- Draftsmen's supplies
- Toothbrush handles

Denied—
- Shower curtains
- Flashing
- Fountain pen and pencil parts
- Beverage tubing

Pyridine

Granted in Full—
- Reagents
- Rubber accelerators
- Sulfa drugs
- Textile treating
- Vitamin manufacture

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.085–$0.109	$0.085–$0.109	$0.085–$0.09
Acid, acetic, 28%, bbl., cwt	3.38 – 3.63	3.38 – 3.63	3.18 – 3.43
Glacial 99.5%, drums	9.15 – 9.40	9.15 – 9.40	8.68 –10.00
U. S. P. X 1, 99.5%, dr	10.95 –11.20	10.95 –11.20	10.50 –11.00
Boric, bbl., ton	109.00–113.00	109.00–113.00	106.00–111.00
Citric, kegs, lb	.20 – .23	.20 – .23	.20 – .23
Formic, cbys., lb	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	1.10 – 1.15	1.10 – 1.15	1.10 – 1.15
Hydrofluoric 30% drums, lb	.08 – .08½	.08 – .08½	.08 – .08½
Lactic, 44%, tech., light, bbl., lb	.073– .075	.073– .075	.073– .075
Muriatic 18°, tanks, cwt	1.05 –......	1.05 –......	1.05 –......
Nitric, 36°, carboys, lb	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –20.00	18.50 –20.00
Oxalic, crystals, bbl., lb	.11¼– .13	.11¼– .13	.11¼– .13
Phosphoric, tech., c'bys., lb	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –......	13.00 –......	13.00 –......
Sulphuric, 66°, tanks, ton	16.50 –......	16.50 –......	16.50 –......
Tannic, tech., bbl., lb	.71 – .73	.71 – .73	.71 – .73
Tartaric, powd., bbl., lb	.70 –......	.70 –......	.70 –......
Tungstic, bbl., lb	nom	nom	nom ......
Alcohol, amyl	......–......	......–......	......–......
From Pentane, tanks, lb	.131–......	.131–......	.131–......
Alcohol, Butyl, tanks, lb	.12½– .14½	.1 ½– .14½	.158–......
Alcohol, Ethyl, 190 p'f., bbl., gal	8.19 – 8.25	8.19 – 8.25	8.19– 8.25
Denatured, 190 proof	......–......	......–......	......–......
No. 1 special, dr., gal. wks	.60 –......	.60 –......	.60 –......
Alum, ammonia, lump, bbl., lb	.03¾– .04	.03¾– .04	.03¾– .04
Potash, lump, bbl., lb	.04 – .04¼	.04 – .04¼	.04 – .04¼
Aluminum sulphate, com. bags, cwt	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt	1.85 – 2.10	1.85 – 2.10	1.85 – 2.10
Aqua ammonia, 26°, drums, lb	.02¼– .03	.02¼– .03	.02¼– .03
tanks, lb	.02 – .02¾	.02 – .02¾	.02 – .02¾
Ammonia, anhydrous, cyl., lb	.16 –......	.16 –......	.16 –......
tanks, lb	.04½–......	.04½–......	.04½–......
Ammonium carbonate, powd. tech., casks, lb	.09¼– .12	.09¼– .12	.09 – .12
Sulphate, wks., ton	29.20 –......	29.20 –......	29.00 –......
Amylacetate tech., from pentane, tanks, lb	.145–......	.145–......	.145–......
Antimony Oxide, bbl., lb	.15 –......	.15 –......	.15 –......
Arsenic, white, powd., bbl., lb	.04 – .04½	.04 – .04½	.04 – .04½
Red, powd., kegs, lb	nom	nom	nom ......
Barium carbonate, bbl., ton	60.00 –65.00	60.00 –65.00	60.00 –65.00
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb	.11 – .12	.11 – .12	.11 – .12
Blanc fix, dry, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt	2.25 – 2.35	2.25 – 2.35	2.25 – 2.35
Borax, gran., bags, ton	44.00 –......	44.00 –......	44.00 –......
Bromine, cs., lb	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	3.00 –......	3.00 –......	3.00 –......
Arsenate, dr., lb	.07 – .08	.07 – .08	.07½– .07¾
Carbide drums, lb	.04½– .05	.04½– .05	.04½– .05
Chloride, fused, dr., del., ton	18.00 –24.00	18.00 –24.00	18.00 –24.00
flake, bags, del., ton	18.50 –25.00	18.50 –25.00	18.50 –25.00
Phosphate, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb	.05½–......	.05½–......	.05½–......
Tetrachloride drums, gal	.73 – .80	.73 – .80	.73 – .80
Chlorine, liquid, tanks, wks., 100 lb	2.00 –......	2.00 –......	2.00 –......
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb	1.84 – 1.87	1.84 – 1.87	1.84 – 1.87
Copperas, bgs., f.o.b., wks., ton	18.00 –19.00	18.00 –19.00	18.00 –19.00
Copper carbonate, bbl., lb	.18 – .20	.18 – .20	.18 – .20
Sulphate, bbl., cwt	5.15 – 5.40	5.15 – 5.40	5.15 – 5.40
Cream of tartar, bbl., lb	.57 –......	.57 –......	.57 –......
Diethylene glycol, dr., lb	.14 – .15½	.14 – .15½	.14 – .15½
Epsom salt, dom., tech., bbl., cwt	1.90 – 2.00	1.90 – 2.00	1.90 – 2.00
Ethyl acetate, drums, lb	.12 –......	.12 –......	.12 –......
Formaldehyde, 40%, bbl., lb	.05½– .06	.05½– .06½	.05½– .06
Furfural, tanks, lb	.09 –......	.09 –......	.09 –......
Fusel oil, drums, lb	.18 – .19	.18 – .19	.18 – .19
Glaubers salt, bags, cwt	1.05 – 1.10	1.05 – 1.10	1.05 – 1.10
Glycerine, c.p., drums, extra, lb	.18¾–......	.18¾–......	.18¾–......
Lead:			
White, basic carbonate, dry casks, lb	.08½–......	.08½–......	.08½–......
White, basic sulphate, sck., lb	.07½–......	.07½–......	.07½–......
Red, dry, sck., lb	.09¼– .09½	.09¼–......	.09¼–......
Lead acetate, white crys., bbl., lb	.12½– .13	.12½– .13	.12½– .13
Lead arsenate, powd., bag, lb	.11 – .12	.11 – .12	.11 – .12
Lime, chem., bulk, ton	8.50 –......	8.50 –......	8.50 –......
Litharge, powd., csk., lb	.08½–......	.08½–......	.08½–......
Lithopone, bags, lb	.04¼– .04½	.04¼– .04½	.04¼– .04½
Magnesium carb., tech., bags, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½

The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to November 12

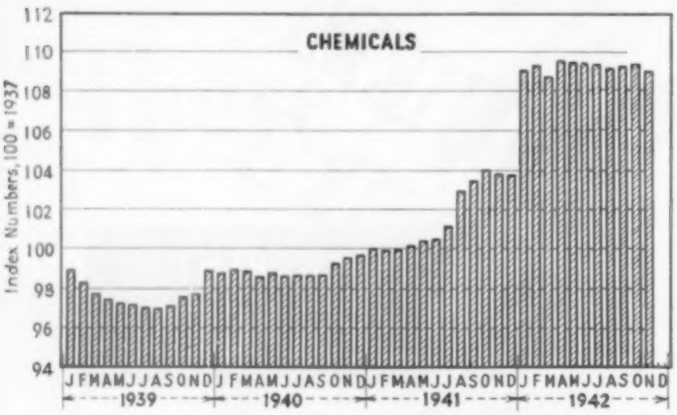
CHEM & MET CURRENT PRICES

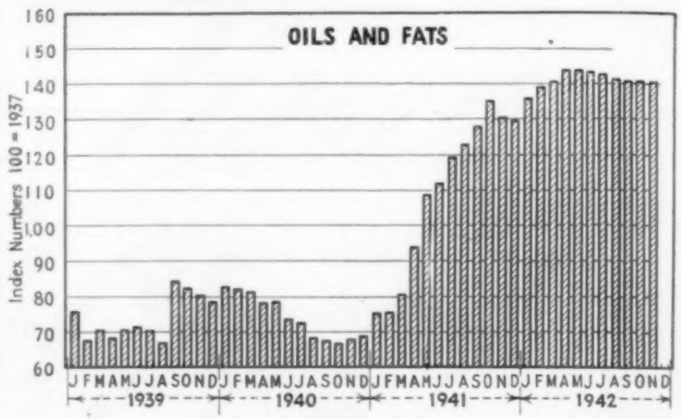
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.60 –......	.60 –......	.60 –......
97%, tanks, gal	.60 –......	.60 –......	.60 –......
Synthetic, tanks, gal	.28 –......	.28 –......	.28 –......
Nickel salt, double, bbl., lb	.13½– .13½	.13½– .13½	.13½– .13½
Orange mineral, csk., lb	.12¼–......	.12¼–......	.12¼–......
Phosphorus, red, cases, lb	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb	.09½– .10	.09½– .10	.09½– .10
Carbonate, 80-85%, calc. csk., lb	.06¼– .07	.06¼– .07	.06¼– .07
Chlorate, powd., lb	.10 – .12	.10 – .12	.10 – .12
Hydroxide (c'stic potash) dr., lb	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 60% bags, unit	.53½–......	.53½–......	.53½–......
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb	.19½– .20	.19½– .20	.19½– .20
Prussiate, yellow, casks, lb	.17 – .18	.17 – .18	.17 – .18
Sal ammoniac, white, casks, lb	.0515– .06	.0515– .06	.0515– .06
Salsoda, bbl., cwt	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	17.00 –......	17.00 –......	17.00 –......
Soda ash, light, 58%, bags, contract, cwt	1.05 –......	1.05 –......	1.05 –......
Dense, bags, cwt	1.10 –......	1.10 –......	1.10 –......
Soda, caustic, 76%, solid, drums, cwt	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, del., bbl., lb	.05 – .06	.05 – .06	.05 – .06
Bicarbonate, bbl., cwt	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb	.07½– .08	.07½– .08	.07½– .08
Bisulphate, bulk, ton	16.00 –17.00	16.00 –17.00	16.00 –17.00
Bisulphite, bbl., lb	.03 – .04	.03 – .04	.03 – .04
Chlorate, kegs, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½
Cyanide, cases, dom., lb	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb	.08 – .09	.08 – .09	.08 – .09
Hyposulphite, bbl., cwt	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt	2.50 – 2.65	2.50 – 2.65	2.50 – 2.65
Nitrate, bulk, cwt	1.35 –......	1.35 –......	1.35 –......
Nitrite, casks, lb	.06¾– .07	.06¾– .07	.06¾– .07
Phosphate, tribasic, bags, lb	2.70 –......	2.70 –......	2.70 –......
Prussiate, yel. drums, lb	.10½– .11	.10½– .11	.10½– .11
Silicate (40° dr.), wks., cwt	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60-62%, dr. lb	.03 – .03½	.03 – .03½	.03 – .03½
Sulphite, crys., bbl., lb	.02¼– .02¼	.02¼– .02½	.02¼– .02½
Sulphur, crude at mine, bulk, ton	16.00 –......	16.00 –......	16.00 –......
Chloride, dr., lb	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb	.07 – .08	.07 – .08	.07 – .08
Flour, bag, cwt	1.90 – 2.40	1.90 – 2.40	1.90 – 2.40
Tin Oxide, bbl., lb	.55 –......	.55 –......	.55 –......
Crystals, bbl., lb	.39½–......	.39½–......	.39½–......
Zinc, chloride, gran., bbl., lb	.05¾– .06	.05 – .06	.05 – .06
Carbonate, bbl., lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb	.10¼–......	.10¼–......	.10¼–......
Zinc oxide, lead free, bag, lb	.07¼–......	.07¼–......	.07¼–......
5% leaded, bags, lb	.07¼–......	.07¼–......	.07¼–......
Sulphate, bbl., cwt	3.85 – 4.00	3.85 – 4.00	3.85 – 4.00

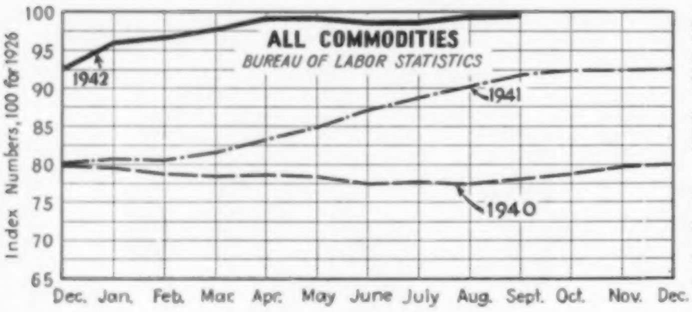
OILS AND FATS

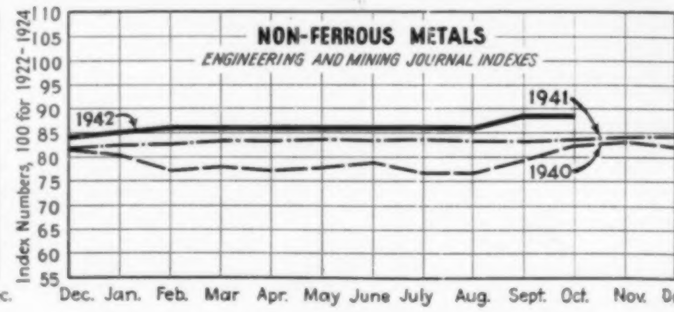
	Current Price	Last Month	Last Year
Castor oil, No. 3 bbl., lb	$0.13¾–$0.14¼	$0.13¾–$0.14½	$0.13¾–$0.13
Chinawood oil, bbl., lb	.38 –......	.38 –......	.38 –......
Coconut oil, Ceylon, tank, N. Y., lb	nom	nom	nom ......
Corn oil crude, tanks (f.o.b. mill), lb	.12¾–......	.12¾–......	.12¾–......
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.12½–......	.12½–......	.12½–......
Linseed oil, raw car lots, bbl., lb	.128–......	.133–......	.113–......
Palm, casks, lb	.09 –......	.09 –......	.09 –......
Peanut oil, crude, tanks (mill), lb	.13 –......	.12¾–......	.13 –......
Rapeseed oil, refined, bbl., lb	nom	nom	nom ......
Soya bean, tank, lb	.11¾–......	.11¾–......	.11¾–......
Sulphur (olive foots), bbl., lb	nom	nom	nom ......
Cod, Newfoundland, bbl., gal	nom	nom	nom ......
Menhaden, light pressed, bbl., lb	.117–......	.117–......	.117–......
Crude, tanks (f.o.b. factory) lb	.088–......	.088–......	.088–......
Grease, yellow, loose, lb	.08½–......	.08½–......	.08½–......
Oleo stearine, lb	.09½–......	.09½–......	.09½–......
Oleo oil, No. 1	.11½–......	.11½–......	.11½–......
Red oil, distilled, dp.p. bbl., lb	.11½–......	.11½–......	.11½–......
Tallow extra, loose, lb	.08½–......	.08½–......	.08½–......

Chem. & Met.'s Weighted Price Indexes









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb	$0.52– $0.55	$0.52 –$0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U.S.P., dr., lb	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S.P., kgs., lb	.54 – .56	.54 – .56	.54 – .56
Benzyl chloride, tech., dr., lb	.23 – .25	.23 – .25	.23 – .25
Benzol, 90%, tanks, works, gal	.15 –......	.15 –......	.14 –......
Beta-naphthol, tech., drums, lb	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb	.11 –......	.11 – .11	.10½– .11
Cresylic acid, dr., wks., gal	.81 – .83	.81 – .83	.81 – .83
Diethylaniline, dr., lb	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluol, bbl., lb	.18 – .19	.18 – .19	.18 – .19
Dip oil, 15%, dr., gal	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, dr. f.o.b. wks., lb	.60 –......	.60 –......	.70 –......
H-acid, bbl., lb	.45 – .50	.45 – .50	.45 – .50
Naphthalene, flake, bbl., lb	.07 – .07½	.07 – .07½	.07 – .07½
Nitrobenzene, dr., lb	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb	.47 – .49	.47 – .49	.47 – .49
Phenol, U.S.P., drums, lb	.13 –......	.13 –......	.13 –......
Picric acid, bbl., lb	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal	1.70 – 1.80	1.70 – 1.80	1.70 – 1.80
Resorcinol, tech., kegs., lb	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb	.33 – .40	.33 – .40	.33 – .40
Solvent naptha, w.w., tanks, gal	.27 –......	.27 –......	.27 –......
Tolidine, bbl., lb	.86 – .88	.86 – .88	.86 – .88
Toluol, drums, works, gal	.33 –......	.33 –......	.32 –......
Xylol, com., tanks, gal	.26 –......	.26 –......	.26 –......

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech, bbl., lb	.19 – .20	.18 – .19	.23 – .26
China clay, dom., f.o.b. mine, ton	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb	.0335– .30	.0335– .30	.0335– .30
Prussian blue, bbl., lb	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb	.11 – .26	.11 – .26	.11 – .26
Chrome green, bbl., lb	.21½– .30	.21½– .30	.21½– .30
Carmine, red, tins, lb	4.60 – 4.75	4.60 – 4.75	4.60 – 4.75
Para toner, lb	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb	3.05 – 3.10	3.05 – 3.10	3.20 – 3.25
Chrome yellow, C.P., bbl., lb	.14½– .15½	.14½– .15½	.14½– .15½
Feldspar, No. 1 (f.o.b.N.C.), ton	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb	.08 – .10	.08 – .10	.08 – .10
Gum copal Congo, bags, lb	.09 – .30	.09 – .30	.09 – .30
Manila, bags, lb	.09 – .15	.09 – .14	.09 – .15
Demar, Batavia, cases, lb	.10 – .22	.10 – .20	.10 – .22
Kauri, cases, lb	.18 – .60	.18 – .60	.18 – .60
Kieselguhr (f.o.b. mines), ton	7.00 –40.00	7.00 –40.00	7.00 –40.00
Magnesite, calc, ton	64.00 –......	64.00 –......	65.00 –......
Pumice stone, lump, bbl., lb	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb	nom	nom	nom
Rosin, H., 100 lb	4.02 –......	4.01 –......	3.13 –......
Turpentine, gal	.70 –......	.64 –......	.83 –......
Shellac, orange, fine, bags, lb	.39 –......	.39 –......	.38 –......
Bleached, bonedry, bags, lb	.39 –......	.39 –......	.35 –......
T. N. Bags, lb	.31 –......	.31 –......	.28 –......
Soapstone (f.o.b. Vt.), bags, ton	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc. 200 mesh (f.o.b. Vt.), ton	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
200 mesh (f.o.b. Ga.), ton	6.00 – 8.00	6.00 – 8.00	6.00 – 8.00

Industrial Notes

B. F. STURTEVANT Co., Hyde Park, Boston, has opened a new branch plant at LaSalle, Ill. The new plant will serve as the company's mid-west production center superseding the plant at Sturtevant, Wisc. which was recently closed. J. F. Gibson is superintendent of the new plant and F. Herlan is general manager of the mid-western division.

CHAIN BELT Co., Milwaukee, announces that A. W. Thomas, sales manager of the construction machinery division has gone to Washington as a consultant to WPB. His duties have been taken over by D. A. Kalton.

PITTSBURGH STEEL Co., Pittsburgh, has promoted Henry A. Roemer, Jr. from manager of sales of steel and wire products to assistant general manager of sales. Norman F. Melville has been made manager of sales of steel and wire products.

GENERAL ELECTRIC Co., Schenectady, has appointed K. R. Van Tassel manager of sales of the newly formed Integral-horsepower motor section. D. A. Yates of the same division has been placed in charge of the motor group in the plant at Lynn, Mass.

ALLIS-CHALMERS MFG. Co., Milwaukee, has placed Selden H. Gorham in charge of dealer sales where he will supervise approximately 400 dealers throughout the country. H. P. Binder has been moved from assistant manager of the hydraulic department to manager of the centrifugal pump department.

MILTON ROY PUMPS, Philadelphia, has added William J. Simpson to its engineering staff. Mr. Simpson will work on development and manufacturing problems.

THE NIAGARA CHLORINE PRODUCTS CORP., Lockport, N. Y., has been dissolved so far as its corporate existence is concerned but the business is continued by George M. Pope and James S. Waters under a partnership arrangement.

ARMSTRONG CORK Co., Lancaster, Pa., has advanced Kenneth O. Bates to the office of vice-president and general manager of the floor division. He is succeeded as general sales manager by C. N. Painter.

THE GLIDDEN Co., Cleveland, has moved its eastern headquarters from Long Island City to Tonnelle Ave., North Bergen, N. J. Ralph Bennett is manager of the division.

TRIUMPH EXPLOSIVES, INC., Elkton, Md., has completely changed its management and directorate. John H. Lucas, vice-president of the Peoples-Pittsburgh Trust Co., Pittsburgh, is now president and Robert D. Ferguson, a lawyer from the same city is vice-president, secretary, and treasurer. Seven prominent Pittsburgh business and professional men make up the new board.

METAL & THERMIT CORP., New York, has appointed Merritt L. Smith assistant sales manager. Mr. Smith also will continue to direct the advertising activities of the corporation.

ANOTHER NEW UNIT IN AMERICA'S
WAR PRODUCTION STRENGTH
by PITTSBURGH·DES MOINES!

★ ★ ★ ★ ★

These construction views of an Eastern plant, built for volume production of certain war materials, show a typically Pittsburgh-Des Moines job of design, fabrication and erection—meeting exacting requirements with speed and craftsmanship—under a single contract, with one responsible guarantee. ● An unusual feature of this project: three large office-locker-restroom units built in the monitor, permitting unobstructed use of main floor for production.

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SEATTLE, 1107 EIGHTH AVENUE SOUTH

CHEM & MET NEW CONSTRUCTION

	Current Projects Proposed Work	Current Projects Contracts	Cumulative 1942 Proposed Work	Cumulative 1942 Contracts
New England	....	$140,000	$2,630,000	$4,475,000
Middle Atlantic	$110,000	4,420,000	7,071,000	109,236,000
South	215,000	....	11,600,000	84,373,000
Middle West	....	3,330,000	102,645,000	189,645,000
West of Mississippi	2,150,000	1,770,000	188,607,000	388,939,000
Far West	....	1,480,000	20,880,000	136,862,000
Canada	10,970,000	265,000	25,930,000	2,802,090
	$13,445,000	$11,405,000	$359,363,000	$916,332,000

PROPOSED WORK

Ala., Mobile—Mobile Paper Mill Co., Inc., Crichton, R. E. Hartman, Pres., is having plans prepared by F. Clarke, Archt., Merchants National Bank Bldg., for the construction of an addition to its paper mill. Estimated cost $100,000.

Louisiana—Houston Pipe Line Co., Petroleum Bldg., Houston, Tex., plans to construct a 10 in. oil pipe line under and across Bayou Vermillion in Vermillion and Jefferson Davis Parishes.

Louisiana—Shell Pipe Line Corp., Shell Bldg., Houston, Tex., plans to construct 10 in. pipe lines in Calcasieu and Jefferson Davis Parishes.

Louisiana—Texas Pipe Line Co., Texas Co. Bldg., Houston, Tex., plans to construct a 10 in. oil pipe line across Black Bayou, Calcasieu Parish.

N. J., Jersey City—Colgate-Palmolive Peet Co., 105 Hudson St., Jersey City, is having plans prepared for the construction of a 5 story soap manufacturing plant. Estimated cost $60,000.

N. C., Kings Mountain—Solvay Process Co., Milton Ave., Solvay, N. Y., plans the construction of a mineral plant.

Pa., Genessee—Genessee Chemical Co., Calvin Carpenter, Gen. Mgr., plans to rebuild its 1 story chemical factory recently destroyed by fire. Estimated cost $50,000.

Texas—American Republics Petroleum Co., Petroleum Bldg., Houston, Tex., will soon receive bids for remodeling its plant. Estimated cost $2,000,000.

Tex., Kilgore—R. Lacy Refining Co., Longview, plans to reconstruct certain units of its cracking plant. Estimated cost may exceed $150,000.

Canada—Department of Munitions & Supply, Ottawa, Ont., plans to construct chemical and explosives plants. Estimated cost between $9,000,000 and $12,000,000.

B. C., Vancouver—Moulded Plywoods, Ltd., 1852 West Georgia St., plans to construct a plastic products and wood factory.

B. C., Vancouver—Vermiloils Ltd., 800 Hall Bldg., plans to construct a mining and smelting plant. Estimated cost $50,000.

Ont., Belleville—Canadian Oil Co., Terminal Bldg., Toronto, Ont., plans to construct an aviation gasoline depot on Dundas St. Estimated cost $50,000.

Ont., Toronto—Orkent Oil Co., Ltd., c/o E. C. Cattanach, 85 West Richmond St., plans to construct a refinery. Estimated cost $40,000.

Que., Montreal—B-A Oil Co., Ltd., Canada Cement Bldg., Montreal, Que., plans to construct a 12x51x60 ft. addition to its plant at Montreal East.

Saskatchawan, Canada—Owner c/o Saskatchawan Industrial Development Board, Regina, contemplates the construction of a plant for the manufacture of industrial and anhydrous alcohol. Estimated cost $270,000.

CONTRACTS AWARDED

California—U. S. Government, Wash., D. C., has awarded the contract for the construction of a detinning plant to H. K. Ferguson Co., 1650 Hanna Bldg., Cleveland, O. Estimated cost including equipment $1,400,000.

Calif., San Francisco—Metten & Gebhardt, 1775 Egbert St., have awarded the contract for rebuilding part of 2 story, 90x350 ft. tannery to Fred J. Early, Jr., 369 Pine St., San Francisco.

D. C., Washington—U. S. Government has awarded the contract for the construction of a detinning plant to H. K. Ferguson Co., Cleveland, O. Estimated cost including equipment $70,000.

Illinois, Indiana, Ohio and Pennsylvania—War Emergencies Pipeline, Inc., B. E. Hull, Vice Pres., Little Rock, Ark., (Cities Service Oil Co., Atlantic Refining Co., Consolidated Oil Corp., Sun Oil Co., Socony-Vacuum, Inc., Tidewater Associated Oil Co., Texas Co., Gulf Refining Co., Shell Oil Co., Pan American Petroleum & Transport Co. and Standard Oil Co. of N. J.), have awarded the contract for the construction of an 875 mi. 24 in. pipeline from Norris City, Ill., to Phoenixville, Pa., to Williams Bros. Corp., National Bank of Tulsa Bldg., O. E. Dempsey Construction Co., Kennedy Bldg., Anderson Bros. and Sheehan Pipe Line Construction Co., National Bank of Tulsa Bldg., all foregoing in Tulsa, Okla.; Oklahoma Contracting Co., Magnolia Bldg., Dallas, Tex., C. S. Foreman Co., New York Life Bldg., Kansas City, Mo. and Ray E. Smith Construction Co., Eldorado, Kan. Estimated cost $60,000,000.

Illinois—U. S. Government, Wash., D. C., has awarded the contract for the construction of a detinning plant to H. K. Ferguson Co., Cleveland, O. Estimated cost including equipment $2,000,000.

Indiana—U. S. Government, Wash., D. C., has awarded the contract for the construction of a detinning plant to be leased to the Metal & Thermit Co., to H. K. Ferguson Co., Cleveland, O. Estimated cost including equipment $130,000.

Maryland—U. S. Government, Wash., D. C., has awarded the contract for the construction of a detinning plant to H. K. Ferguson Co., Cleveland, O. Standard Metal Refining Co., lessee. Estimated cost $100,000.

Massachusetts—U. S. Government, Wash., D. C., has awarded the contract for the construction of a tin can shredding plant to H. K. Ferguson Co., Cleveland, O. Estimated cost including equipment $70,000.

Michigan—U. S. Government, Wash., D. C., has awarded the contract for the construction of a tin can shredding plant to H. K. Ferguson Co., Cleveland, O. Estimated cost including equipment $70,000.

Missouri—U. S. Government, Wash., D. C., has awarded the contract for the construction of a tin can shredding plant to H. K. Ferguson Co., Cleveland, O. Estimated cost including equipment $70,000.

Nev., Toy—United Tungsten Mines, Ltd., F. D. LeMon, Pres., 139 North Virginia St., Reno, will construct a tungsten mill using its own forces.

New Jersey—U. S. Government, Wash., D. C., has awarded the contract for the construction of a detinning plant to H. K. Ferguson Co. Cleveland, O. Metal & Thermit Corp. lessee. Estimated cost $100,000.

N. J., Carteret—Westvaco Chlorine Chemical Co., Roosevelt Ave., has awarded the contract for the construction of a 3 story factory to Wallace J. Wilck, 280 Hobart St., Perth Amboy. Estimated cost $80,000.

New York—U. S. Government, Wash., D. C., has awarded the contract for the construction of detinning plants to H. K. Ferguson Co., Cleveland, O. Estimated cost $4,000,-000.

Ohio—U. S. Government, Wash., D. C., has awarded the contract for the construction of tin can shredding plants to H. K. Ferguson Co., Cleveland, O. Esimated cost $210,000.

O., Cleveland—National Cylinder Gas Co., H. W. Gray, Pres., 3965 Jennings Rd., has awarded the contract for a 1 story, 100x140 ft. oxygen building, 80x80 ft. acetylene building to Campbell-Lowrie & Lautermilch, 400 West Madison Ave., Chicago, Ill. Estimated cost $60,000.

O., Lorain—Brush Beryllium Co., Lorain, has awarded the contract for the construction of a chemical and smelter plant to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost $750,000.

Pennsylvania—U. S. Government, Wash., D. C., has awarded the contract for the construction of a tin can shredding plant to H. K. Ferguson Co., Cleveland, O. Estimated cost including equipment $70,000.

Rhode Island—U. S. Government, Wash., D. C., has awarded the contract for the construction of a tin can shredding plant to H. K. Ferguson Co., Cleveland, O. Estimated cost including equipment $70,000.

Texas—U. S. Government, Wash., D. C., has awarded the contract for the construction of a detinning plant to H. K. Ferguson Co., Cleveland, O. Estimated cost including equipment $700,000.

Wisconsin—U. S. Government, Wash., D. C., has awarded the contract for the construction of a tin can shredding plant to H. K. Ferguson Co., Cleveland, O. Estimated cost including equipment $70,000.

Wis., Milwaukee—Harnischfeger Corp., 4400 West National Ave., has awarded the contract for the construction of a 1 story, 62x77 ft. chemical storage building to R. L. Resinger & Co., 733 West Van Buren St., Milwaukee.

Wyoming—U. S. Government, Wash., D. C., has awarded the contract for the construction of a refinery to be leased to Frontier Refinery, Cheyenne, to Fluor Corp., 2500 Atlantic Blvd., Los Angeles, Calif. Estimated cost will exceed $1,000,000.

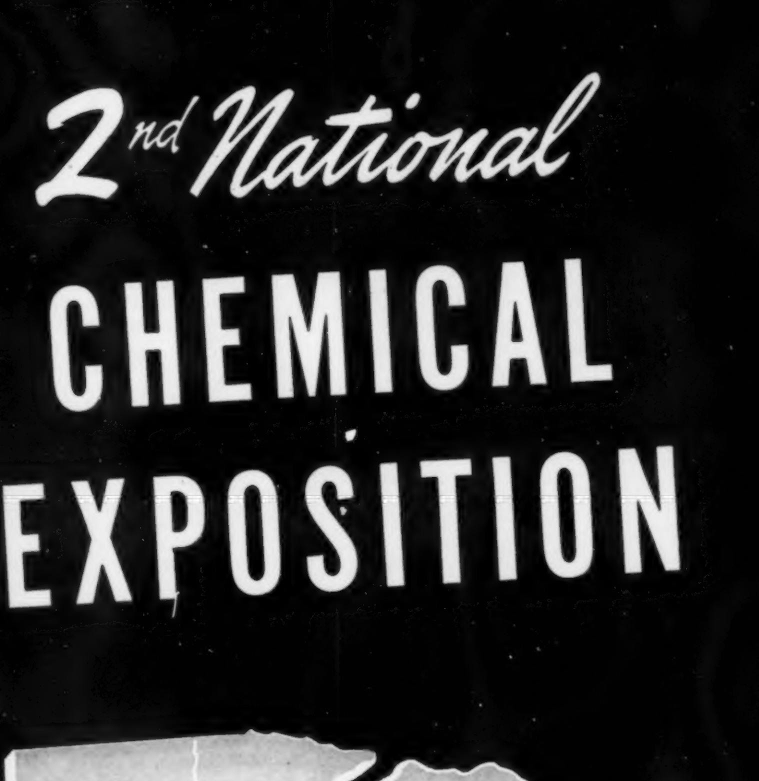
Ont., Toronto—Canadian Industries, Ltd., Paint & Varnish Division, foot of Laugston St., has awarded the contract for altering its 2 story, 24x82 ft. plant to Mollenhauer Contracting Co., Ltd., 188 Perth Ave. Estimated cost $59,000.

Que., Quebec City—Dominion Oxygen Co., Ltd., 159, Bay St., Toronto, Ont., has awarded the contract for the construction of a plant to Magloire & Cauchon, 311 De La Salle St., at $165,739.

Que., Tingwick—Nicolet Asbestos Mines, Ltd., Tingwick, has awarded the contract for the construction of mines buildings to Tremblay & Bonin, 137 Ninth Ave., Sherbrooke, Que. Estimated cost $40,000.

GUIDE AND DIRECTORY

2nd National CHEMICAL EXPOSITION



NOV. 24, 25, 26, 27, 28, 29

HOTEL SHERMAN

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★ EXHIBITORS ★

	Booth No.
Ainsworth & Sons, Inc., William, 2151 Lawrence St., Denver, Col.	58
Alloy Products Corp., 221 Madison St., Waukesha, Wis.	153
Alox Corporation, Buffalo Ave. & Iroquis St., Niagara Falls, N. Y.	194-195
American Heat Reclaiming Corp., 1270 6th Ave., New York, N. Y.	125
American Instrument Co., 8030-8050 Georgia Ave., Silver Spring, Maryland	67
American Resinous Chemicals Corp., 103 Foster St., Peabody, Mass.	113
Ampco Metal, Inc., 1745 South 38th St., Milwaukee, Wis.	99
Angel & Co., H. Reeve, 7 & 11 Spruce St., New York, N. Y.	120
Armour & Co., 1355 W. 31st St., Chicago, Ill.	132
Atlas Powder Co., Wilmington, Del.	107-108
Atlas Publishing Co., 133 W. 21st St., New York, N. Y.	53
Bareco Oil Co., Box 2009, Tulsa, Oklahoma	72
Bennett Mfg. Co., 14600 Princeton Ave., Chicago, Ill.	98
Brabender Corp., Rochelle Park, N. J.	174
Buffalo Foundry & Machine Co., 1551 Filmore Ave., Buffalo, N. Y.	143
Bump Pump Co., LaCrosse, Wis.	101
Campbell Co., The, 3 Egg Harbor Road, Hammonton, N. J.	156
Central Scientific Co., 1700 Irving Park Rd., Chicago, Ill.	178
Chemical & Metallurgical Engineering, 330 W. 42nd St., New York, N. Y.	141
Chicago Pump Co., 2336 Wolfram St., Chicago, Ill.	110
Chemical Industries, 552 5th Ave., New York, N. Y.	76-77
Commercial Solvents Corp., Terre Haute, Ind.	150-151
Consolidated Products Co., Inc., 15 Park Row, New York N. Y.	182
Corning Glass Works, Corning, N. Y.	169
Corn Products Sales Co., 17 Battery Place, New York, N. Y.	51-52
Croll-Reynolds Co., 17 John St., New York, N. Y.	125
Daily Chemical Market, 133 W. 21st St., New York, N. Y.	53
Darco Corp. 60 E. 42nd St., New York, N. Y.	107-108
deBeers & Associates, F. M., 20 N. Wacker Dr., Chicago, Ill.	125
Denver Equipment Co., 1400 17th St., Denver, Colo.	131
Dicalite Co., 120 Wall St., New York, N. Y.	168
Dorr Co., Inc., 570 Lexington Ave., New York, N. Y.	89-90
duPont de Nemours & Co., E. I., Wilmington, Del.	100
Durametallic Corp., Kalamazoo, Mich.	117-118
Eimer & Amend, 635 Greenwich St., New York, N. Y.	115-116
Emery-Carpenter Container Co., 147 W. 41st St., New York, N. Y.	173
Engelhard, Inc., Chas., 90 Chestnut St., Newark, N. J.	59-60-61
Ertel Engineering Corp., 40 W. 48th St., New York, N. Y.	197
Eutectic Welding Alloys Co., 40 Worth St., New York, N. Y.	195-196
Fansteel Metallurgical Corp., 2200 Sheridan Rd., North Chicago, Ill.	134
Federal Classifier Systems, Inc., 127 N. Dearborn St., Chicago, Ill.	164
Filter Paper Co., The, 57 E. 24th St., Chicago, Ill.	63
First Machinery Corp., 819-837 E. 9th St., N. Y. C.	188
Fisher Scientific Co., 717 Forbes St., Pittsburgh, Pa.	115-116
Fitzpatrick Co., The W. J., 111 N. Canal St., Chicago, Ill.	177
Fletcher Works, Glenwood Ave. & 2nd St., Philadelphia, Pa.	125
Food Industries, 330 W. 42nd St., New York, N. Y.	141
General Ceramics Co., Keasbey, N. J.	81
Glycerine Producers' Association, 9 S. Clinton St., Chicago, Ill.	157
Glyco Products Co., Inc., 230 King St., Brooklyn, New York, N. Y.	62
Goslin-Birmingham Mfg. Co., 350 Madison Ave., New York, N. Y.	125
Graver Tank & Mfg. Co., Inc., 4809 Tod Ave., East Chicago, Indiana	104
Gump Co., B. F., 431 S. Clinton St., Chicago, Ill.	87-88
Haering & Co., Inc., D. W., 205 W. Wacker Dr., Chicago, Ill.	50
Hamilton Mfg. Co., 1316 18th St., Two Rivers, Wis.	144-147
Hammond Drierite Co., W. A., 108 Dayton St., Yellow Springs, Ohio	54
Hanovia Chemical & Mfg. Co., Chestnut St. & N. J. R. R. Ave., Newark, N. J.	59-61
Hardinge Co., Inc., 240 Arch St., York, Pa.	82
Haveg Corp., Newark, Delaware	121
Hercules Powder Co., Wilmington, Del.	129-130
Honan-Crane Corp., 409 Indianapolis Ave., Lebanon, Indiana	181
Huppert Co., K. H., 152 West Walton, Chicago, Ill.	97
Illinois Electric Porcelain Co., Macomb, Ill.	65
Industrial & Engineering Chemistry, 330 W. 42nd St., New York, N. Y.	122-126
Industrial Instruments, Inc., 156 Culver Ave., Jersey City, N. J.	92
Infilco Inc., 325 W. 25th Place, Chicago, Ill.	102
Insto-Gas Corp., 1900 E. Jefferson Ave., Detroit, Mich.	56
Johns-Manville, 22 E. 40th St., New York, N. Y.	83-84
Kewaunee Mfg. Co., End South Center St., Adrian, Mich.	179-180
Kimble Glass Co., Vineland, N. J.	142
Kold-Hold Mfg. Co., 424 No. Grand Ave., Lansing, Mich.	73
Koppers Co., Pittsburgh, Pa.	68-69-70
Lapp Insulator Co., LeRoy, N. Y.	95
Leader Iron Works, Inc., Decatur, Ill.	42
Lithgow Corporation, 333 W. 40th Place, Chicago, Ill.	155
Loeb Equipment Supply Co., 910 No. Marshfield Ave., Chicago, Ill.	55
Ludlow-Saylor Wire Co., The, Newstead Ave. & Wabash R. R., St. Louis, Mo.	85-86
Lukens Steel Co., Coatesville, Pa.	136-139
Marathon Paper Mills Co., Rothschild, Wis.	96
McGraw-Hill Publishing Co., 330 W. 42nd St., New York, N. Y.	141
Merck & Co., Inc., Rahway, N. J.	105-106
Merco Nordstrom Valve Co., 400 No. Lexington Ave., Homewood Pittsburgh Pa.	40
Metal-Glass Products, Co., 1 Reed St., Belding, Mich.	166-167
Mojonnier Bros. Co., 4601 W. Ohio St., Chicago, Ill.	78
Morse Magneto Clock Co., 17 E. 42nd, New York, N. Y.	91
National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.	149
National Technical Laboratories, 820 Mission St., South Pasadena, Calif.	23-24
Ohio Chemical & Mfg. Co., 1177 Marquette St., Cleveland, Ohio	119
Olson Filtration Engineers, 4630 W. Flournoy St., Chicago, Ill.	94
Omega Machine Co., 3409 E. 18th St., Kansas City, Mo.	140
Permutit Co., The, 330 W. 42nd St., New York, N. Y.	79
Peterson & Co., Inc., Leonard, 1222 Fullerton Ave., Chicago, Ill.	176
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Raymond Pulverizer Division, Combustion Engineering Co. Inc., 1319 No. Branch St., Chicago, Ill.	111
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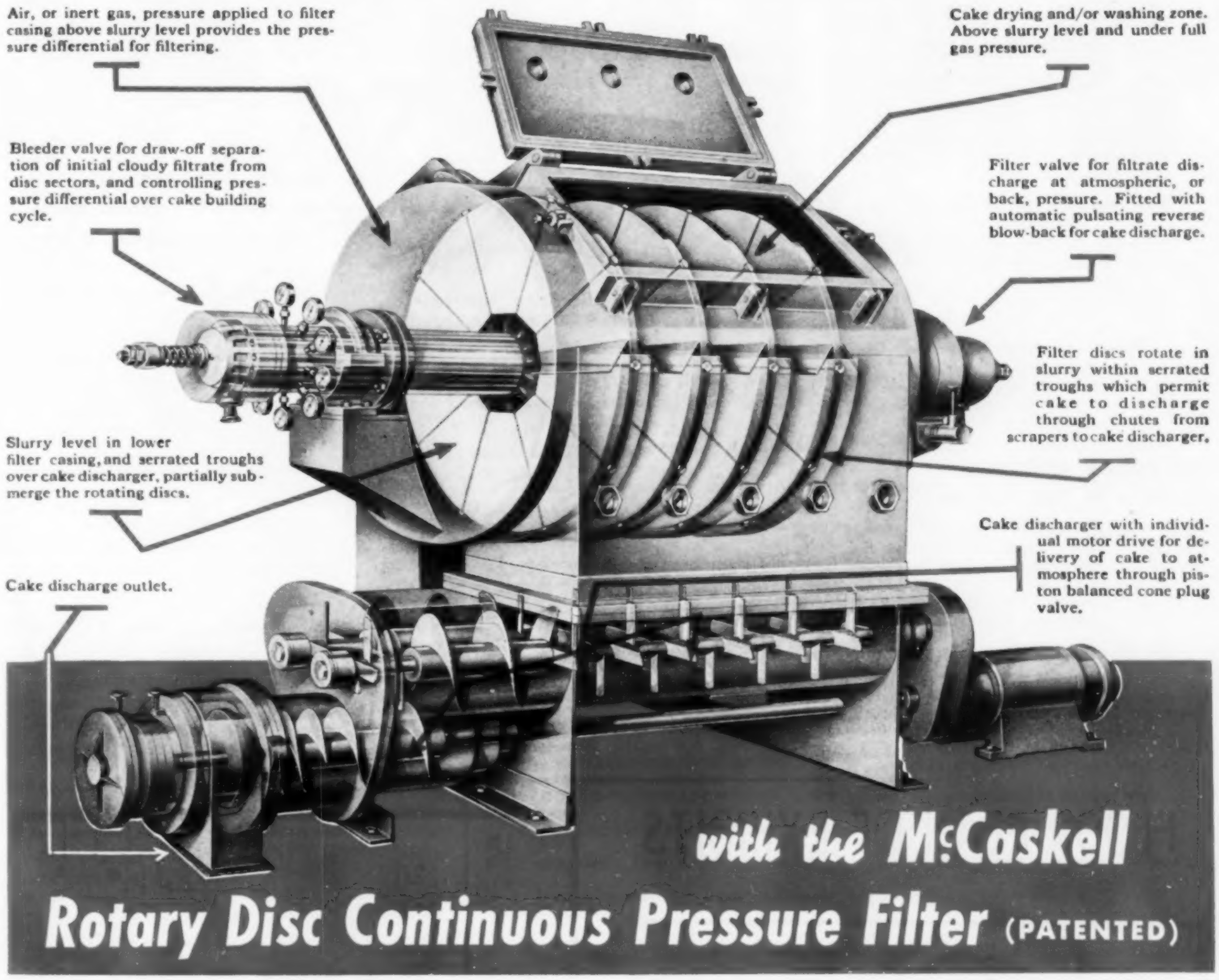
Index as supplied by National Chemical Exposition, corrected to Nov. 2

Now . . . CONTINUOUS PRESSURE FILTRATION



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★ PROGRAM ★

NATIONAL INDUSTRIAL CHEMICAL CONFERENCE

WEDNESDAY AFTERNOON

November 25, 1942, 2:00-4:00 pm

"Plastics and Paper"

Presiding, NORMAN L. SHEPARD
Chemical Director, American Cyanamid Company, New York, New York

"Raw Material Supplies for Plastics Manufacture"

By ARTHUR E. PETERSEN
Chief of Organic Plastics and Resins Section, Materials Division, Chemical Branch, War Production Board, Washington, D. C.

"Paper and Paper Materials"

By ALLEN ABRAMS
Vice-President in Charge of Research and Development, Marathon Paper Mills Company, Rothschild, Wisconsin

THURSDAY EVENING

November 26, 1942, 6:30 pm

Joint meeting of the National Industrial Chemical Conference and the Chicago Section of the American Chemical Society.

Presiding, R. C. NEWTON
Vice-President, Swift & Company, Chicago, Illinois

"The Electron Microscope in Relation to Chemical Research"

By V. K. ZWORYKIN
Associate Director, Research Laboratories RCA Manufacturing Company Camden, New Jersey

FRIDAY AFTERNOON

November 27, 1942, 2:00-5:00 pm

"Food and the Relation of Food to the Chemistry of Plants and the Soil"

Presiding, C. G. KING, Scientific Director, The Nutrition Foundation, Inc. New York, New York

"The Soil and Crop Basis of Better Nutrition"

By L. A. MAYNARD
Director, School of Nutrition and the United States Plant Soil and Nutrition Laboratory, Cornell University, Ithaca, New York

"Soil Fertility and the Human Species"

By W. A. ALBRECHT
Chairman Department of Soils, College of Agriculture, Columbia, Missouri

"Food and Nutrition as Related to War"

By C. G. KING, Scientific Director
The Nutrition Foundation, Inc.
New York, New York

FRIDAY EVENING

November 27, 1942, 8:00-9:15 pm

Presiding, VICTOR CONQUEST
Director of Research, Armour & Company
Chicago, Illinois

"The Cyclotron and Its Uses in Research"

By P. GERALD KRUGER
Department of Physics, University of Illinois, Urbana, Illinois

SATURDAY AFTERNOON

November 28, 1942, 1:45-5:00 pm

"A Symposium on Industrial War Problems"

Presiding, C. S. MINER,
Director, Miner Laboratories, Chicago, Illinois

"Control of War Time Incendiaries"

By WARD V. EVANS
Professor of Chemistry, Northwestern University, Evanston, Illinois

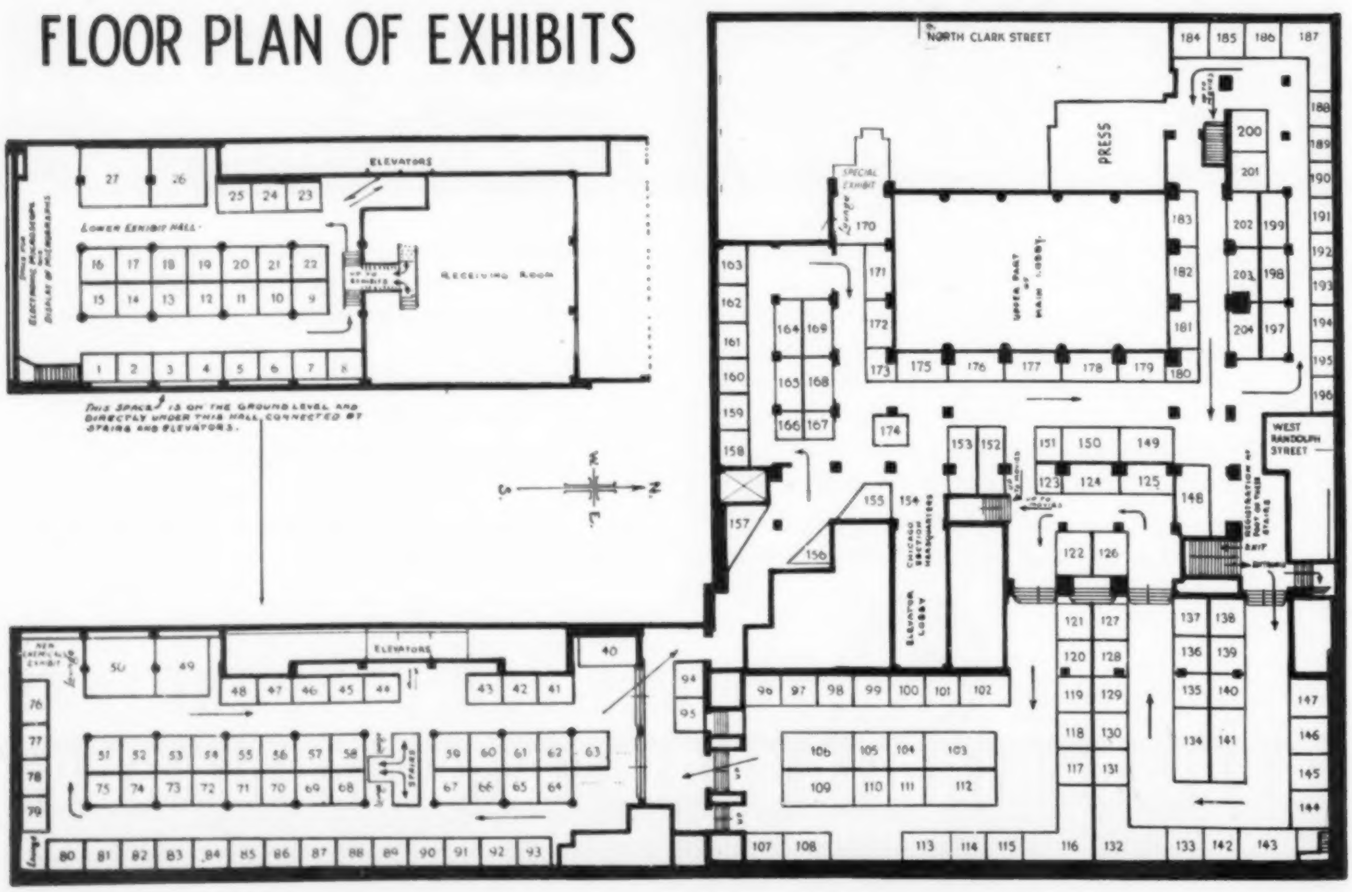
"Waste Treatment in Industry as Related to War Economy"

By F. W. MOHLMAN
Director of Laboratories,
Sanitary District of Chicago, Chicago, Illinois

"The Salvage and Conservation of Chemicals in Industry"

By S. DONALD PERLMAN
Executive Chemical Director, Industrial Salvage Section, Conservation Division, War Production Board

FLOOR PLAN OF EXHIBITS



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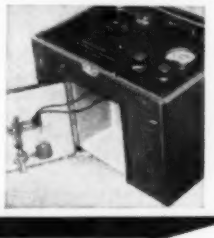

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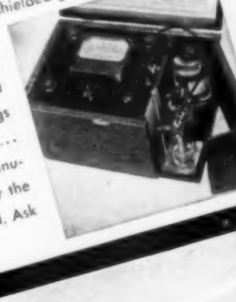

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Haveg Corp.
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Permutit Co., The
Schneible Co., Claude B.

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General Ceramics Co.
Haveg Corp.
The U. S. Stoneware Co.

ACID RESISTANT LININGS AND COVERINGS
deBeers & Associates, F. M.

ACID RESISTING MATERIALS
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deBeers & Associates, F. M.
Ertel Engineering Corp.
General Ceramics Co.
Haering & Co., Inc., D. W.
Haveg Corp.
Lukens Steel Co.
Metal-Glass Products Co.
Pfaudler Co., The
Sheldon & Co., E. H.
Titanium Alloy Mfg. Co., The
U. S. Stoneware Co., The

ACIDS
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Koppers Co.
Schaar & Co.

ADHESIVES
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Atlas Powder Co.
Corn Products Refining Co.

AGITATORS
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General Ceramics Co.
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Hardinge Co., Inc.
Haveg Corp.
Koppers Co.
Metal-Glass Products Co.
Mojonnier Bros. Co.
Pfaudler Co., The
Sperry & Co., D. R.
U. S. Stoneware Co., The

AIR CONDITIONING APPARATUS
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York Ice Machinery Corp.

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Commercial Solvents Corp.
Schaar & Co.

ALLOYS—Ferrous
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Koppers Co.
Titanium Alloy Mfg. Co., The

ALLOYS—Non-Ferrous
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Koppers Co.
Titanium Alloy Mfg. Co., The
Waukesha Foundry Co.

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ANODES
U. S. Stoneware Co., The

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ASBESTOS
Ertel Engineering Corp.
Johns-Manville Sales Corp.

AUTOCLAVES
Alloy Products Corp.
American Instrument Co.
Metal-Glass Products Co.
Pfaudler Co., The
Schaar & Co.

AUTOMATIC TEMPERATURE CONTROL
American Instrument Co.
Sarco Co., Inc.
Wheelco Instruments Co.
Wilkens-Anderson Co.

BALANCES & WEIGHTS
Ainsworth & Sons, Inc., Wm.
American Instrument Co.
Central Scientific Co.
Fisher Scientific Co.
Sargent & Co., E. H.
Schaar & Co.
Wilkens-Anderson Co.

BARRELS & DRUMS
Bennett Mfg. Co.
Fisher Scientific Co.
Haveg Corp.

BASKETS—Dipping and other
General Ceramics Co.
Haveg Corp.
Metal-Glass Products Co.
U. S. Stoneware Co., The

BEARINGS
Ampco Metal, Inc.
Koppers Co.

BINS
Graver Tank & Mfg. Co., Inc.
Koppers Co.
Leader Iron Works, Inc.
Metal-Glass Products Co.

BLENDERS
Metal-Glass Products Co.
National Engineering Co.
Pfaudler Co., The
Pulverizing Machinery Co.
Sarco Co., Inc.

BLOWERS
Federal Classifier Systems, Inc.
General Ceramics Co.
Haveg Corp.
Sheldon & Co., E. H.

BOOKS—Technical
Reinhold Publishing Corp.

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Ertel Engineering Corp.
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Mojonnier Bros. Co.

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U. S. Stoneware Co., The

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BRICK—Refractory
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U. S. Stoneware Co., The

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Selas Co., The
Wilkens-Anderson Co.

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Leonard Peterson & Co., Inc.
Sheldon & Co., F. H.

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CALORMETERS
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Sargent & Co., E. H.
Schaar & Co.
Wilkens-Anderson Co.

CANS
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Marathon Paper Mills Co.

CARBON
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Commercial Solvents Corp.
Darco Corp. (Activated)
Filter Paper Co., The (Activated)

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Central Scientific Co.

CARS—Tank
Alloy Products Corp.
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Dorr Co., The
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Fansteel Metallurgical Corp.
Federal Classifier Systems, Inc.
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Haveg Corp.
Koppers Co.
Leader Iron Works, Inc.
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National Engineering Co.
National Technical Laboratories
Permutit Co., The
Pfaudler Co., The
Pulverizing Machinery Co.
Raymond Pulverizer Div. of Combustion Engineering Co., Inc.
Selas Co., The
Sheldon & Co., E. H.
U. S. Stoneware Co., The

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U. S. Stoneware Co., The

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Corn Products Refining Co.
Glyco Products Co., Inc.
Haering & Co., Inc., D. W.
Hercules Powder Co.
Koppers Co.
Marathon Paper Mills Co.
Merck & Co., Inc.
Permutit Co., The

CHEMICALS—Laboratory
Atlas Powder Co.
Central Scientific Co.
Commercial Solvents Corp.
Corn Products Refining Co.
Fisher Scientific Co.
Glyco Products Co., Inc.
Merck & Co., Inc.
Ohio Chemical & Mfg. Co., The
Sargent & Co., E. H.
Schaar & Co.
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